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NATURAL HISTORY.

VOLUME III.

ARTICLE I.—*Notes on Some Illinois Microgasters: with Descriptions of New Species.* By CLARENCE M. WEED, M. Sc.

[In working over the material by which the interesting group of Microgasters is represented in the collections of the Laboratory, so much of interest was found that it was thought worth while to record at this time some of the more important facts. The writer desires to express his thanks to Prof. S. A. Forbes for permission to study the collections and use the notes, as well as for many other favors; to Dr. C. V. Riley, who has very kindly verified the determinations; and to Dr. A. S. Packard, Prof. H. Garman, and Mr. Chas. W. Woodworth for favors received.]

MICROPLITIS CERATOMIÆ, Riley.

This species was bred by Dr. Riley from *Ceratomia quadricornis*, in Missouri.* During the summer of 1885, from a larva of the sphinx just mentioned, confined in a breeding cage at Champaign, there emerged eighty-four of the Microplitis grubs, which spun parallel, leathery, ribbed cocoons upon the back of their host. The cocoons were formed in two longitudinal series, one on each side of the dorso-median line of the larva, which were connected with a posterior transverse series. On the 25th of May, 1886, the adults began to emerge, and continued to issue until June 5. They agree with Riley's description (l. c.), except that they are larger, the majority of them being 3 mm. long, and some even reaching 3.5 mm. The depth of coloring of the costa and stigma varies considerably in the same lot of specimens, in the majority of them being of the normal piceous, but in occasional specimens becoming lighter. From another lot of Ceratomia larvæ, there were obtained August 1 of the same season, similar cocoons, the adults from which began to emerge August 12, and all had issued within a few days thereafter. Dr. Riley mentions (l. c.) having bred this large variety from masses of cocoons spun regularly side by side, as were our specimens, but having no ribs as ours have.

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*Notes on North American Microgasters, Trans. St. Louis Acad. Sci., Vol. IV., p. 303 [8].

MICROPLITIS MAMESTRÆ, sp. n.

Under this name I describe a well-marked species bred from the larvæ of *Mamestra picta*, at Normal, in 1884. In a breeding cage containing a large lot of Mamestra larvæ there were noticed July 2, two specimens, each having a peculiar ribbed cocoon fastened transversely between the anal prolegs. These cocoons were isolated, and August 23 there had emerged from them the two *Microplitis* females here described.

Cocoon.—5 mm. long, 2 mm. wide. Reddish brown, cylindrical, with a pointed cap at each end, and about ten slightly oblique ribs running longitudinally. Tough and without loose threads. The cap forms a perfect circle, and in the specimens at hand one on each cocoon had been entirely separated by the insect before emerging. The corners are well developed, so that a longitudinal section, without the caps, would be of the form of a rectangular parallelogram.

Described from two specimens found attached, singly, between the anal prolegs of larvæ of *Mamestra picta*, Harr.

Imago, ♀.—Length, 3 mm. Black; antennæ, mandibles, and labrum, reddish brown; palpi, and legs, including whole of coxæ, and more or less of the under side of abdomen, together with a portion of the margins of terga of first and second abdominal segments ferruginous; claws blackish. Wings hyaline; tegulæ, with inner portions of costa and nervures, approaching ferruginous (being slightly more yellowish than legs), and outer portion testaceous. Inner half of stigma same color as inner portions of costa, nearly transparent; outer portions darker, clouded. Antennæ not quite as long as body; joints 3–15, slightly constricted at middle, the terminal joint appearing flattened when seen from above, and enlarged at the middle and tapering to a point when seen from the side. Mesonotum confluently punctured. Metanotum coarsely reticulated, the posterior margin of the metascutum being raised, and the metascutellum having a prominent longitudinal median carina. Abdomen shorter than thorax; basal segment vertical, the tergum finely reticulated, with a median groove extending from anterior margin two thirds of its length, and a slight tubercle on middle of posterior margin; tergum of second and following segments smooth and shining, with sparse pubescence. Radial vein arising from middle of stigma, nearly forming a right angle with basal nervure of the quadrate areolet: a white spot on cubital vein at base of areolet, and another on the vein closing the areolet exteriorly, just before its juncture with the cubital vein. Side of stigma bordering first cubital cell very slightly swollen; that bordering radial cell straight. Apical nervures slender, but easily seen.

Described from two females bred from *Mamestra picta*, Harr.

This species is very distinct from *M. ceratomiæ*, Riley, and is easily distinguished from *M. gortynæ*, Riley, by its larger size, quadrate areolet, red posterior coxæ, etc.

APANTELES CONGREGATUS, Say.

A long series of this abundant and variable species is to be found in the Laboratory collections. Adult specimens have been taken with the sweep-net at Normal, McLean County, July 1, 1882, and June 27, 1883; at Anna, Union County, September 13, 1883; and at Urbana, Champaign County, June 15, 1885. Some were also collected in woods near Pekin, Tazewell County, August 14, 1883, and still others were found among some collections made by beating the foliage of *Ampelopsis quinquefolia* at Urbana, May 23, 1885.

Large numbers of specimens of this Apanteles have also been bred at various times from the larvæ of our two common species of tomato-worms, — *Phlegethontius carolina*, and *P. celeus*. Cocoons obtained from the former species were received from Swanwick, Ill., Sept. 1, 1884, and within five days the flies had all emerged. Another lot was bred at Normal during the same season, the dates of emergence from the cocoons being almost the same as for those just mentioned. In 1879, another series was bred from larvæ of this sphinx in August. During August, 1882, and September, 1884, these parasites were also bred from *P. celeus*, one lot being collected at Normal, and the other at Godfrey. The cocoons of all these specimens were of the usual white kind, with little loose silk.

The variety of *A. congregatus* bred by Mr. Scudder from *Pieris rapæ*, described by Dr. Packard* as *Microgaster pieridis*, and referred by Dr. Riley† to the species mentioned (the variety name *pieridivora* being substituted for *pieridis*, because the latter was preoccupied), was frequently bred during the summer of 1886 from larvæ of *Pieris rapæ*, brought to the Laboratory because they showed signs of disease. Especial mention may be made of three lots of the parasites bred by Prof. Garman, the cocoons of one lot being of a lemon-yellow color; those of another being of about the same shade, excepting a slight greenish tinge in some specimens; and those of the third being creamy white, with scarcely a trace of yellow. Yet there is no mentionable difference in the adults of the different lots. There were, on an average, about thirty cocoons obtained from each *Pieris* larva.

The Apanteles larvæ of one set emerged from the skin of their host August 11, and came forth from the cocoons as adults August 29. Another lot formed cocoons September 2, and the adults were found dead in the breeding box September 22.

On page 104 of the Twelfth Report of the State Entomologist of Illinois, Prof. Forbes has described an Apanteles bred from the larvæ of *Mesographe (Orobena) rimosalis*, Guenée, under the name *Apanteles orobenæ*. A critical examination of a larger series of specimens than was then at hand, shows that this is but a variety of *Apanteles congregatus*, distinguished by the dark anterior and intermediate coxæ and trochanters. In some specimens these parts of the front and middle legs are almost as light-colored as in the normal specimens from sphinx larvæ. Hence these insects should be known as *A. congregatus*, Say, var. *orobenæ*, Forbes.

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*Proc. Bost. Soc. Nat. Hist., Vol. XXI., p. 26.

†Am. Nat., Vol. XVI., p. 680.

APANTELES MILITARIS, Walsh.

This well-known species, as would be expected from a knowledge of its habits, was found in especial abundance during the years when the army worm was destructive. In 1882 specimens were sent to the office by Mr. D. S. Harris, of Cuba, Ill., with the statement that he had bred them from the army worm, which was then very abundant in that vicinity. Durring the same season, this notorious pest was destructively abundant in certain portions of McLean County, but its operations were rapidly checked by *A. militaris*, which is the species referred to by Prof. Forbes on page 102 of his First Report (the twelfth of the series). Describing the history of a brood of worms observed in a certain field, he writes: "When first noticed, on the 24th of June, these worms were doing serious damage to a heavy growth of timothy on high ground, marching from one side of the lawn to the other. By the 3d of July, the season for the transformation to pupæ had been reached, but apparently not over twenty-five per cent. of the worms succeeded in effecting the change, the remainder dying in such numbers that the ground was reeking with a sickening stench. At the same time clusters of the cocoons of one of the common parasites of the army worm were found everywhere abundant on the surface of the ground, and in some cases on the dried remains of the army worm itself. Of seventy-six pupæ of the worm, collected in this field at this time, but one reached maturity." From cocoons collected in this field July 2, the adult Apanteles continued to emerge until July 20.

The only specimens bred in 1886 were from a mass of thirty-nine white cocoons loosely fastened togther, parallel to each other, found on a leaf of Indian corn in the field, August 2. The flies emerged August 11.

APANTELES CACŒCIÆ, Riley.

A single specimen (♀) of this species was bred during May, 1886, from a larva of *Teras minuta*, Robinson (*malivorana*, Le B.; *cinderella*, Riley). The cocoon was attached to a leaf. It is thin and white, 6 mm. long and about one third as wide.

APANTELES SARROTHRIPÆ, sp. n.

On June 30, 1884, there was noticed in a breeding cage, at Normal, containing larvæ of *Sarrothripa lintneriana*, a dead larva in an imperfect cocoon, surrounded by cocoons of some hymenopterous parasite. A few days later there emerged from the latter six specimens of a well-marked Apanteles, for which I propose the above name. Unfortunately the cocoons were not saved, so that I am unable to describe them at this time.

Imago.—Length 2.5 mm. ♂, ♀. Black; palpi white; labrum and mandibles testaceous; antennæ ferruginous; legs light red except posterior coxæ, which are black. Wings hyaline; tegulæ whitish; veins pale yellow except apical portion of costa which, with the stigma, is testaceous. Lateral membranous margins of terga of the three anterior segments, posterior portion of tergum of third segment, and sides and ventrum of abdomen, testaceous, lighter anteriorly. Dorsal portion of abdomen, except the two anterior terga, piceo- testaceous. Mesonotum shining, with distant, very shallow, punctures, many specimens having a slightly depressed area on the posterior portion of the mesoscutum, each side of the dorso- median line. Scutellum of metathorax with punctures on its anterior portion, and finely reticulated posteriorly; without median carina. Tergum of first abdominal segment longer than wide, finely rugose, narrowing behind. Tergum of second segment also finely rugose, the wrinkles diverging obliquely from the anterior margin: sides membranous. Terga of remaining segments smooth and shining. Ovipositor concealed. Radial vein arising slightly beyond the middle of the stigma.

Described from six specimens (5 ♀, 1 ♂) bred from a larva of *Sarrothripa lintneriana.*

Much resembling *A. congregatus* and *A. smerinthi*, but easily distinguished from former by its shining mesonotum, and from latter by the rugose abdominal terga.

APANTELES ORNIGIS, sp. n.

In the mines made by the larvæ of the apple Ornix *(O. geminatella,* Pack.) in apple leaves, at Normal, there were found March 21, 1886, many peculiar white, banded, cocoons of some hymenopterous parasite. Between April 27 and May 10 there emerged specimens of a new species of Apanteles, for which the above name is proposed. When the cocoons were collected, the Apanteles larvæ had not yet changed to pupæ.

This seems to be a common parasite of the Ornix named, as it was very abundant in the Normal nursery; and I have found it almost everywhere in the State where its host has been observed.

Cocoon.—Length, 3 mm. Width, 1 mm. Oblong cylindrical; smooth, white, with a darker appearing central band about .5 mm. wide. The darker appearance of this band is caused, not by any difference in the color of the silk, but because the cocoon is there very much thinner than at the ends. To each end is attached a cord of fine silken threads, which are also fastened to the sides of the leaf-mine, thus suspending the cocoon after the manner of a hammock.

Imago.—Length 2 to 2.5 mm. ♂, ♀. Black; palpi white; labrum and mandibles piceo-testaceous. Legs of female light red except base of posterior coxæ, apical half of posterior tibiæ, and posterior tarsi, which are dusky. First pair of legs of male light red, except coxæ and apical joint, which are blackish; second pair with more or less black on coxæ, femora, and tibiæ; posterior pair fuscous, with proximal portions of femora and tibiæ lighter, and coxæ black. Sides and ventral portions of anterior segments of the abdomen with more or less testaceous coloring, especially in the males. Wings hyaline; tegulæ piceous; veins testaceous; stigma darker. Antennæ piceous; slightly longer than the body. Scutum of mesothorax with rather distant shallow punctures, shining; scutellum also shining, with a few very shallow punctures. Scutellum of metathorax large, quadrate, reticulated, without median carina. Terga of first two abdominal segments and base of tergum of third segment finely reticulate; remainder smooth and shining. Tergum of basal segment narrowing posteriorly, with membranous testaceous borders. Ovipositor one third as long as abdomen. Radial vein arising beyond the middle of the stigma.

Described from twelve specimens (8 ♂, 4 ♀), bred from *Ornix geminatella*, Pack.

APANTELES CRAMBI, sp. n.

On the 13th of June, 1886, I found in a breeding cage containing larvæ of the root web worm, *Crambus zeëllus*, Fernald, collected in the vicinity of Champaign, a Crambus cocoon containing a dead larva and several Microgaster cocoons. From the latter there emerged between June 19 and 22 several specimens of a well-marked species of Apanteles, for which the above name is proposed. Specimens exactly similar were bred during July from larvæ of *Crambus exsiccatus* infesting lawns at Champaign. Doubtless this insect will aid materially in checking the ravages of these species of Crambus which are so difficult to subdue by artificial means.

Cocoon.—Length, 3 mm. White, thin, loosely fastened together within the cocoon of the host.

Imago.—Length, 2 mm. ♂, ♀. Black; palpi white; mandibles testaceous; ventrum of abdomen, together with the tergum of the third abdominal segment testaceous, lighter anteriorly. Terga of segments posterior to third, piceo-testaceous. Legs light red, except claws of front and middle pair, and tips of femora, together with the tarsi of posterior pair, which are piceo-testaceous, and posterior coxæ, which are black, tipped with red. Wings hyaline; tegulæ and proximal portion of costa testaceous; stigma and apical portion of costa darker, nearly piceous; veins whitish. Antennæ piceous; those of female shorter than the body, of male slightly longer. Mesothorax closely punctured, shining. Scutellum of metathorax reticulate. Terga of two first abdominal segments longitudinally rugulose, remainder smooth and shining. Ovipositor concealed. Radius arises slightly beyond the middle of the stigma.

Described from many specimens, bred from larvæ of *Crambus zeëllus*, Fernald, and *C. exsiccatus*, Zeller.

ARTICLE II. — *Jassidæ of Illinois.* PART I.* By CHARLES W. WOODWORTH, M. S.

FAMILY JASSIDÆ STÅL.

The insects included under the name Jassidæ, form a large and well-defined natural group. They are readily distinguishable from members of the allied families as follows: from Cicadidæ by the possession of but two ocelli (or none) instead of three, as in the latter family; from Cercopidæ by having broad transverse posterior coxæ instead of conical ones, and having the posterior tibiæ prismatic instead of round; and, lastly, from Membracidæ by having the thorax only slightly convex and not strongly declivous. Aside from this there is a general resemblance between forms of the same family, so that they may be very readily distinguished at a glance; but the above characters are useful chiefly for doubtful cases, before the student becomes familiar with the various forms.

By Linnæus, in his *Systema Naturæ*, this family together with the above enumerated related ones was first all included in the single genus Cicada, which was thus characterized:

"Rostrum inflexed. Antennae setaceous. Wings 4, membranous, deflexed. Feet (generally) saltatorial."

Later, Geoffroy proposed the name Tettigonia for those having but two ocelli, reserving Cicada for those having three ocelli situated on the vertex. Fabricius in his *Entomologia Systematica*, 1794, seems to have misunderstood Geoffroy, for he used Tettigonia for Cicada and applied the latter name to our present group Jassidæ, having separated from them the Cercopidæ and Membracidæ as genera, giving them the names Cercopis and

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*The present article includes only the subfamily Tettigoninæ. I hope soon to complete the remaining part.

I have made use of the collections and library of the State Laboratory of Natural History in preparing the present paper, and wish here to acknowledge the kind favors and encouragement received from the Director, Prof. S. A. Forbes.

Membracis, so that, transposing the names Tettigonia and Cicada, we have a series of genera nearly equivalent to the families of later systematists. I say nearly, because a few aberrant forms of Jassids (such as Ledra) were included in the Membracidæ. A few other genera were established by Fabricius, in his later writings, by the dismemberment of these groups, and subsequent authors have added greatly to the list of genera, so that now as many as two hundred have been proposed, of which perhaps half may stand the test of time.

STRUCTURE.

As in all other true insects, the body is composed of a series of more or less irregular chitinous rings, called segments, disposed in three regions, the head, thorax, and abdomen. The head in this group is very variable in shape, but always somewhat triangular when seen directly from before or from behind, the two large and often prominent eyes forming the upper corners, and the beak arising from the much reflexed apex. The first of the three segments which comprise the thorax is very prominent above, but small and nearly covered by the inflexion of the head beneath. The other segments are closely connected, and about equal above and below. The abdomen consists of seven or eight segments tapering backwards and provided near the tip with a rather large genital apparatus.

Head. Returning now to the head, we can distinguish two surfaces besides the backside, which is concealed by the thorax: one above, the dorsal surface, more or less flat; and the other, called the face, often very convex, and including all that portion looking downward, forward, and to the sides. These planes are separated by a more or less distinct edge known as the front edge.

Above the head, between the eyes, and generally surrounding them, a large variable piece, not very distinctly marked off from the one in front, may be seen, which is known as the vertex (Pl. I., Fig. 3). The separation from the piece before it, is quite distinct at the sides of the vertex, being by sutures (Pl. I., Figs. 1, 2), but often not so at the middle, where it may not be visibly divided at all.

The vertex is sometimes inflexed over the front edge of the head, and sometimes does not reach it.

In front of or below the vertex, and often not distinctly separable from it, the face extends as a long median piece upon the front, often presenting somewhat the shape of an inverted pear. The upper end varies in shape and position with the size and shape of the vertex. The clypeus is a piece attached to the lower end of the face. It varies much in shape, being round, square, expanded at base or at apex, or constricted at the middle or near the base. On either side of the clypeus is a more or less elongate piece, the lora, which also covers a portion of the face; the inner margin is quite straight, and the outer, curved and sometimes constricted at its upper end.

The remaining portion of the cheeks consists of broad expanded pieces, which may for convenience be divided into two parts,— one forming a somewhat elevated plane or ridge above the antennæ and entirely in front of the eyes, and the other being on a lower plane than the rest of the front. The outer edge of this lower portion of the cheeks is variable, being sometimes bent outward, sometimes inward, but always forming a thin sharp edge.

The eyes are somewhat oval organs, situated at the upper posterior corners of the head. They are finely granulate. On the anterior edge, near the antennæ, there is in some species, a considerable notch: otherwise the margin is entire.

Of even more importance, from a systematic point of view, are the ocelli. These are small round organs often situated on low elevations. In position they are constant in their variation, and therefore of the highest value for classification. Their normal position seems to be at the junction of the vertex, front, and cheeks. In the Tettigoninæ they are on the middle of the vertex; in Acocephalini, just before the eyes, on the front edge of the head; in Allygus, and its allies, on the face,— etc.

The antennæ of Jassidæ (Pl. I., Fig. 4) are almost uniformly setaceous; the basal joint is very large, rounded, about as wide as long; the second is much smaller, but still quite large, and of nearly the same shape; the third is as much smaller than the second as the second is smaller than the first, being smallest at base, and enlarging nearly to the tip, then decreasing. The succeeding segments are short and decrease regularly in diameter. There are peculiar thickened curved hairs on the third, fourth, and fifth joints. A peculiar form of antenna is found in Idiocerus, having comparatively few joints, and the terminal three or four greatly enlarged into a club.

The mouth parts consist of five pieces; a greatly enlarged labrum, forming a fleshy proboscis surrounding four slender lancet-like processes homologous with the mandibles and maxillæ.

Thorax. The most anterior segment of the thorax, the prothorax, consists of a large dorsal plate above — the pronotum or disk of the thorax. Beneath (Pl. I., Fig. 5), the pleurites and sternum are small, except the episternum, which is often expanded into a broad plate which touches the episternum of the other side along the median line. The pronotum covers the edge of the head before and the base of the wings behind. It is square or hexagonal in shape, the corners being designated (beginning from before) as the anterior, posterior, and scutellar,— the latter, however, are sometimes wanting.

The pleurites are well shown in the figure, and the sternum simply forms the bottom of a groove into which the beak is received. With regard to the two remaining segments little need be said. The dorsal surface is covered by the wings (elytra) to which they give rise, with the exception of a large triangular portion called the scutellum. This piece appears to be composed of part of the dorsum of both segments. The portion covered by the wings is sometimes almost membranous, and is never as strong as the rest of the body wall. The pleurites are on the sides; the epipleuræ are large and distinct; and the episterna are small. The sterna are transverse and the coxæ extremely large.

A pair of legs arises from each thoracic segment (Pl. I., Fig. 6). They are alike in general appearance, except that they increase greatly in size from before backwards and become proportionally more slender and spiny. Each leg consists of (1) a large rounded oval basal joint, the coxa, which is partly received in a hole in the thorax, the coxal cavity; (2) a small, somewhat triangular joint, the trochanter; (3) the femur, a long, thick, and strong joint; (4) a slender, somewhat prismatic, and more or less spiny tibia; and (5) a three-jointed tarsus terminated by a pair of thick slightly curved claws.

The anterior wings, or elytra, are long, rather slender organs, quite hard in texture, forming a shield to the delicate true wings. The inner basal triangular portion, called the clavum or claval area, is separated from the rest of the wings by a bend or suture known as the claval suture. The venation of the anterior wings is of considerable value for classification. The veins arising from the base have been called sectors. The one on the margin is called the marginal vein. Transverse veins are those appearing towards the tip, and connecting sectors or their branches. The areas between the veins are known as basal and apical cells, and when more than one series exists beyond the basal cells, the additional ones are called the anteapical cells. The veins in the clavum are the claval veins. The hind wings have about six sectors, variously forked and united by a few cross-veins, and afford some of the best and most tangible generic characters. The marginal vein does not lie on the margin but parallel with it. It does not extend all around the wings, therefore some of the posterior basal cells are open.

Abdomen. The abdomen consists of five segments in the male and six in the female. They taper gradually towards the tip, where are the large genital organs. Figs. 7–9, Plate I., show the structure of the abdominal plates around the ovipositor.

CLASSIFICATION.

The classification of the Jassidæ has undergone the usual amount of change and confusion and is still not satisfactorily settled; but most authorities agree in placing these insects in a series of quite well-defined groups. Primarily they arrange themselves naturally into two large groups or subfamilies. These subfamilies are characterized by the position of the ocelli. Not that these characters are necessarily of such fundamental importance that we may establish such high groups upon them, but because they seem correlated with other characters harder to express but none the less evident and essential. We will therefore divide this family as follows:

Ocelli situated upon the disk of the vertex ...... Tettigoninæ.
Ocelli situated on the front or near the front margin of the head .... Jassinæ.

SUBFAMILY TETTIGONINÆ.

Two very natural groups of genera can be distinguished as follows:

Body broadly oval flat .... Tribe I. Gyponina.
Body more or less cylindrical .... Tribe II. Proconina.

Tribe I. Proconina Stål.

Genus 1. Oncometopia Stål.

Proconia Am. and Serv., Hist. des Hemip., p. 571 (1843).
Oncometopia Stål, Hemip. Fabr. Part II., p. 62 (1869).

Somewhat cylindrical, with head and anterior parts of the thorax bent downwards at an angle of about 15°, or more. Head with prominent eyes extending laterally beyond the sides of the head. A faint groove behind each ocellus. Ocelli situated on feeble nodules, farther from each other than from the eyes. Vertex not attaining the front margin. Front very convex, with the usual striations extending over the front margin on to the top of the head. Genæ projecting outwards and forwards beyond the margin of the head. Clypeus convex and not entirely separate from the front, extending beyond the margin of the side of the head. Lore rather small but distinct. Pronotum with its sides inflexed, surface irregularly wrinkled by transverse striations formed of coarse punctures. Scutellum triangular, with a depressed transverse line about the middle. Beneath, the coxæ are very large and the mesothoracic episterna are large and flat. Elytra with the apical and anteapical cells remarkably uniform in size. The anterior sector is forked about the middle, and a third fork is given off towards the apex. A narrow apical membrane is present. Claval veins two, sometimes united by one or two cross-veins. First sector of the wing giving off a faint marginal fork, posterior fork connected with the anterior fork of the second sector by a cross-vein. Posterior fork of the second sector likewise connected with the third simple sector. Fourth sector simple, the fifth forked, and the sixth small and simple. The marginal vein turns abruptly to the margin after attaining the posterior fork of the fifth sector. Abdomen with six segments in the female, seven in the male.

Two very dissimilar species in our fauna belong to this genus; *O. undata* Fabr., and *O. costalis* Fabr. The former is long and slender; the head and thorax are much deflexed; the elytra have rather large apical cells; and the claval veins are united with one or more cross-veins; while in the latter species the body is short and thick, with the head and thorax relatively but little deflexed, the apical cells in the elytra small, and the claval veins separate.

These species are known in collections, and in most books, under the generic name Proconia, but Stål has shown (in Hemip. Fabr.) that Proconia Lep. & Serv. is not Proconia of Am. & Serv. He therefore uses Proconia as originally intended and divides Proconia Am. & Serv. into several genera, one of which is Oncometopia.

O. undata Fabr. (Pl. II., Figs. 10–14.)

Cicada undata Fabr. Ent. Syst. IV., p. 32, 23; Fabr. Syst. Rhyng. p. 62, 5.—Coqueb. Illust. 1, p. 32, tab. 8, fig. 3.—Blanch. Hist. Nat. III., p. 192, 160.
Cicada orbona Fabr. Ent. Syst. Sup., p. 520, 25-6; Fabr. Syst. Rhyng. p. 72, 50.
Tettigonia undata Germ. Mag. d'Ent. Tome IV., p. 61, 6.—Sign., Ann. Soc. Ent. Fr. Tome II., p. 486, 225, Pl. 17, fig. 5.
Proconia undata Walk., List of Homop., p. 783, 3.
Proconia nigricans Walk., l. c., p. 783, 8.
Proconia tenebrosa Walk., List of Hemip., p. 787, 16.
Proconia plagiata Walk., List of Homop., p, 788, 17.
Oncometopia undata Stal, Hemip. Fabr., Part II., p. 62.

Cylindrical, slate-blue or gray above, head, scutellum, and the under side reddish yellow.

Length 12 mm.

Head. Above marked with somewhat irregular black lines in the following manner: a line along the hind margin next the thorax; one around the front edge of the head; a pair of lines going backward from this frontal line and uniting, thus forming a pear-shaped cell, from the back edge of which two pairs of lines radiate; an elbowed line to the eyes; and another meeting the front margin at the fore end of the genæ, forming an oval cell. There is often an additional line dividing this cell in halves. The peculiarities of the sculpturing consist in a shallow median longitudinal groove and a pair of shallower and wider ones extending from the ocelli to the hind margin. Beneath irregularly marked with black spots; a median line from the middle of the front edge to the middle of the front; an additional line often present, from the middle of the side of the front edge, parallel with the median line. Generally a faint line on the suture between the clypeus and the front. The lower margin of the eyes is distinctly concave.

Thorax. Pronotum slaty blue or gray, anterior margin reddish yellow, more or less distinctly separated from the darker parts by a sinuous black line; punctures dark or black; base darker. Scutellum bright reddish yellow marked with black as follows: a transverse line on the depressed portion; a pair of longitudinal lines from the outer ends of this to the anterior margin; a short transverse line connecting the middle of these; and, lastly, a still shorter median line connecting the middle of the transverse lines. Besides this the front median area is irregularly spotted with black. Beneath, the thorax is marked with irregular dots and patches of black, variable in form, number, and position, so that all that can be said is that the pleurites of the mesothorax and metathorax are generally darkest. The coxal cavities are large. The elytra are slate-blue or gray with the tips hyaline, the apical cells quite large, and the claval veins connected by one or more transverse veins. The wings are smoky or hyaline.

Abdomen. The abdomen is reddish yellow, all but the lateral edges of the first five dorsal segments and the bases of the sternal pieces, which are black.

Not a very common insect, but may be found at almost any time in all parts of the State. It lives on the grape vine and is said to become so numerous sometimes as to be very injurious.

O. costalis Fabr.

Cercopis costalis Fabr., Syst. Rhyng., p. 96, 44.
Cercopis lateralis Fabr., Ent. Syst. Sup., p. 524, 24-5.—Coqueb., Illust. 1, p. 35, tab. 9, fig. 3.
Cercopis marginella. Fabr., Syst. Rhyng., p 96, 44.
Tettigonia lugens Walk., List Homop., p. 775, 108.
Tettigonia pyrrhotelus Walk., l. c., p. 775, 109.
Tettigonia costalis Sign., Ann. Ent. Soc. Fr. Tome II. (1854), 359, 210.

Black marked with fine yellow spots and two longitudinal red lines on each elytron.

Length 7 mm.

Head. Above evenly marked with a very great number of very small yellow spots. The head is much smoother than in the previous species, there being no indication of a median groove and scarcely any behind the ocelli, which are nearer the hind margin than in that species, the yellow spots along the front margin forming a quite distinct line. Beneath, the surface has likewise the yellow spots, those on the front generally following the striations. Those on the cheeks are fewer and larger, and there are only two or three on the clypeus.

Thorax. Pronotum with the sides less inflexed than in *O. undata*, black, spotted with yellow like the head. Scutellum black, marked with yellowish lines, four on the anterior portion, one pair of which is longitudinal, and the other oblique, lying on the edges of the scutellum. The posterior portion has three lines, an oblique one on either margin and a single longitudinal median one. Sometimes a transverse line is also present on the groove separating the two portions. Beneath, the pleurites have a prominent yellow stripe extending backwards from the posterior corner of the eyes. Below these, several irregular yellow spots are found, larger than those marking the dorsum. Legs black, with the rows of spines on the femur and tibiæ yellow. Elytra black, marked with two broad red bands, one on the costa and one on the sutural edge of the clavum. The cells which are not covered by the red bands are generally margined with yellow. The apical cells are small and the claval veins distinct. Wings as in *O. undata*.

Abdomen. Above black, margined on each side with a broad yellow stripe, the continuation of the stripes on the thorax.

Beneath black, marked, as the head and thorax above, with fine yellow spots.

This species is not so widely and commonly distributed as the preceding, but often occurs in considerable numbers.

GENUS 2. AULACIZES AM. & SERV.

Aulacizes Am. & Serv., Hemip. p. 571 (1843).

Size and general appearance of Oncometopia. Head with less prominent eyes, hardly wider than the thorax; ocelli situated on a nodule which springs from a cavity on the vertex, nearer the eyes than to each other. Vertex flat, having, in addition to the broad shallow pits in which the ocellar nodules rest, three deep, broad sulcations, one larger and median, and the other two situated one on either side between the eye and the ocellus. The front is but little reflexed over the front margin on to the top of the head. It is very convex below. The clypeus is slightly convex. The gulæ extend forwards and outwards, being slightly arched and somewhat enlarged at the tip. The basal joints of the antennæ are also peculiarly enlarged at the tip. Pronotum with its sides inflexed, surface irregularly wrinkled by transverse striations formed of coarse punctures. Scutellum smaller than usual, transversely striate, and not so distinctly separated into an anterior and posterior portion. Behind, it is prolonged into a spinous process. Beneath, the coxæ are very large, and the mesothoracic episterna are large and flat. The venation of the elytra is very variable. The figure shows one form. The cells are irregular both in size and position. There are two cells in the clavum. The wings are much more constant. The first sector gives off a marginal fork, and a cross-vein connects the posterior fork of the first sector with the anterior fork of the second. The second sector forks so near the tip that the cross-vein connecting its posterior fork to the third simple sector is extremely long. Fourth and fifth sectors forked. Marginal vein not attaining the margin till near the sixth simple sector. Abdomen with six segments in the female, seven in the male.

A single species represents this genus in our fauna.

A. irrorata Fabr. (Pl. II., Figs. 15–18.)

Cicada irrorata Fabr., Ent. Syst., IV., p. 33, 24; Fabr., Syst. Rhyng. p. 62, 6.— Coqueb., Illust. 1, p. 32, tab. 8, fig. 3.— Blanch. Hist. Nat. III., p. 192, 17.

Tettigonia rufiventris Walk., List Homop., p. 796, 12.

Tettigonia irrorata Sign., Ann. Soc. Ent. Fr., Tome III. (1852), p. 59, 276.

Size and general appearance of *Oncometopia undata.* Color yellowish brown to black, sprinkled with yellowish white.

Length 12 mm.

Head. Above nearly black, mottled with yellowish white and tinged in places with rose-red. End of gula, above, rosy. Eyes gray, ocelli brown. Beneath, face yellowish marked with red lines in the furrows, and with black irregular projections on the upper and lower edges. From the latter a conspicuous blunt hook-like line extends on each side, and anterior to these lines are eight small symmetrically arranged spots. Clypeus black above, with yellow on the sides. The cheeks are dusky yellow, hairy. with some black near the clypeus. Lore small, as in Oncometopia, color black.

Thorax. Pronotum nearly black, with yellow spots much finer and thicker than those on the head, the deflexed side-margins, however, with fewer and coarser spots. Scutellum small, triangular, basal portion black, middle portion yellow, and extreme tip brown, shading into black on the terminal spine. Beneath yellow. dusky towards the middle, marked with a few black spots. Femur light yellow, basal end black, and apical third brownish yellow; tibiæ and tarsi dark yellow tipped with black. Not so spiny as Oncometopia. Elytra reddish brown irrorate with minute yellow spots, tip hardly hyaline, marginal membrane distinct, venation variable. Wings transparent.

Abdomen. Red above, yellowish beneath, with a broad median and a narrower sutural black line. Female ovipositor black with the sheaths red. The male differs in the still wider median black genital armature.

This fine species is not an uncommon insect, and though easily mistaken for Oncometopia at a first glance is easily distinguishable.

GENUS 3. TETTIGONIA GEOFFR.

Tettigonia Geoffr., Hist. des Ins. I., p. 429.

Body elongate, slender. Head rounded or triangular in front, not wider than the thorax, above generally flat, vertex not reaching the front margin. Front large, convex, striate as usual, the portion reflexed over the front edge only slightly, and sometimes not at all, striate. Clypeus large, generally convex. Ocelli nearer the eyes than to each other. Genæ large, deflexed, tips projecting donwards, and not forwards and outwards as in the preceding genera. Pronotum hexagonal, with the scutellar angles often very obtuse and the outer side much rounded, deflexed at the sides. Scutellum triangular, divided by the usual transverse groove; surface quite smooth. Beneath, the coxæ are very large and the mesothoracic episternum is large and flat. Legs with the tibiæ long, prismatic, and spinulose. Elytra with four different types of venation, with a small marginal membrane. Wings with the second sector having the two branches connected with the first and third simple sectors by short cross-veins. Fourth sector forked and fifth simple. Marginal vein apparently attaining the margin immediately after joining the posterior fork of the fourth sector.

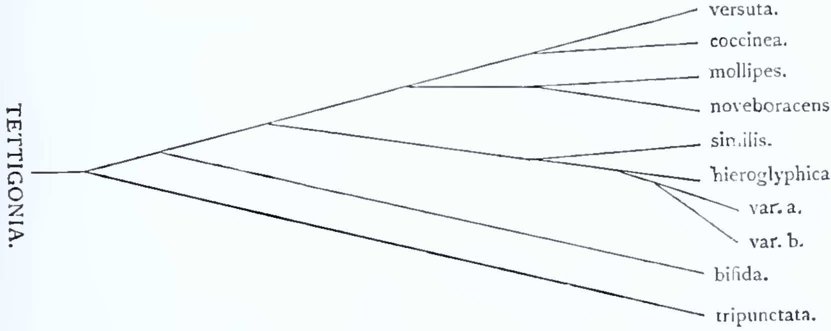
This genus is one of large extent, possessing members both common and variable. Indeed it may be considered one of the dominant groups of insects. Many of our species belong to the genus Diedrocephala, but the characters which separate it from Tettigonia are not of generic importance, as European authors now agree. Nevertheless differences enough do exist to divide it into a number of well-marked subgenera and sections.

One of the most striking of these is represented by a single species, *T. tripunctata* Fitch. The peculiarity of this species consists in the short vertex, the remarkably long front and clypeus, the absence of the anteapical cells in the elytra, and also in the forking of the first sector near the base, so that it appears like an additional sector.

The second section is represented by *T. bifida* of Say, and is characterized by its very short, rounded vertex, the absence of anteapical cells in the elytra, and the almost basal forking of the first sector.

The remaining species group themselves into the two subgenera Diedrocephala and Tettigonia as limited by Signoret, which are distinguishable by the more rounded vertex and front margin of Tettigonia and the more or less conical head of Diedrocephala. To Tettigonia belong *T. similis*, n. sp., *T. hieroglyphica* Say, and two varieties of the latter; and to Diedrocephala, *T. versuta* Say, *T. coccinea* Forst., *T. mollipes* Say, and *T. noveboracensis* Fitch.

The relation of these species is well shown in the following diagram:



The following synopsis will serve to distinguish our species:

TETTIGONIA.

Face not greatly elongate.
Elytra with anteapical cells.
Head more or less flat above, with the front margin distinct. Subgenus I.
But one row of anteapical cells in elytra. Sect. I.
Vertex with two longitudinal black lines. .... T. versuta Say.
Vertex not lineate........T. coccinea Say.
Several rows of anteapical cells. Sect. II.
Head long, with no black spots near the tip. ....T. mollipes Say.
Head shorter, with a pair of black spots near the tip......T. noveboracensis Fitch.
Head rounded at tip, with no distinct front margin.

Subgenus II.

Scutellum with a median black portion.
......................T. SIMILIS, n. sp.
Scutellum with median portion red or yellow.
Color reddish . . . T. HIEROGLYPHICA SAY.
Color slate-green ....var. α.
Color nearly black...............var. β.
Elytra without anteapical cells. Subgenus III.
..........................T. BIFIDA Say.
Face greatly elongated, Subgenus IV.
................T. TRIPUNCTATA FITCH.

SUBGENUS I.

Head conical, front margin distinct. General color green.

SECTION I.

Elytra with a row of apical and one of anteapical cells.

T. versuta Say.

Tettigonia versuta Say, Phila. Acad. Nat. Sci., Vol. 16, p. 311.

Green lineate with red. Head above with black-bordered marginal and light yellowish green median lines.

Length 8 mm.

Head. Above reddish, marked with yellowish green, and with narrow black lines as follows: narrow a black line on the posterior margin and a larger one on the front edge; one on either side of the narrow longitudinal median light stripe; one margining the lateral light stripes; and, lastly, one transverse to this stripe, opposite the genæ. The lateral light stripe sends a small lobe inwards towards the ocelli. Beneath yellowish green without markings, except faint dark lines on some of the striations of the front.

Thorax. Pronotum bluish green, with a large median spot and a lateral line on each side, red, and with the extreme lateral and front edge lighter green. Scutellum orange, with the anterior and posterior extremities yellow, marked with five parallel black longitudinal lines on the anterior portion, the three inner of which are connected by a transverse line on the median impression. From this two lines extend back over the posterior portion. Beneath unicolorous yellowish green. Legs yellowish green with spurs at tip of tibiæ, and tarsal joints brown or black. Elytra dark bluish green with two broad red stripes separated by a blue line; tips and the costa near the tip, spotted brown. Wings dusky brown, veins deep brown.

Abdomen. Beneath yellowish green.

Not rare in southern Illinois in the middle and latter part of the summer.

T. coccinea Forst.

Cicada coccinea Forst., Nov. Species Insect., p. 96.
Tettigonia 4- *vittata* Say, Journ. Acad. Phila., Vol. VI., p. 312, 3.
Proconia 4- *vittata* Fitch, Cat. Ins. N. Y. State Cabinet, p. 55.
Diedrocephala coccinea Uhler, List Hemip. West of Miss. R., p. 91.

Green lineate with red. Head with black anterior border, but unmarked above.

Length 10 mm.

Head. Above orange, eyes green, front margin prominently marked with a black band. The usual narrow black line running inwards from the genæ is present. Beneath uniform yellowish green, lateral edges of eyes dark.

Thorax. Pronotum green, marked with a transverse red line near the front margin, from which project backwards and outwards a pair of heavier curved lines. A yellow scar on the anterior corners. Scutellum deep orange, apical spines lighter. Beneath green, pleurites margined with a deep black stripe above, which is the continuation of that on the margin of the head. Legs yellowish, spurs on tips of tibæ, and tarsal joints, brown. Elytra bluish green, with two longitudinal stripes red, the outer one being the wider and having a green central portion; tips black. Wings nearly black.

Abdomen red above, yellowish green beneath.

Common throughout the State. It has the same general appearance as *T. versuta* but is quite distinct.

SECTION II.

Elytra with several rows of irregular cells at the tip.

T. mollipes Say. (Pl. III., Figs. 19–23.)

Tettigonia mollipes Say, Journ. Acad. Phila., Vol. VI., p. 312, 4.
Aulacizes mollipes Fitch, Cat. Ins. N. Y. State Cabinet, p. 56.
Diedrocephala mollipes Uhler, List Hemip. West of Miss. R., p. 92.

Bright green, head acutely conical.

Length 12 mm.

Head. Above light yellowish green, marked with very narrow black lines: one line in a median shallow groove; a double-curved one on either side, extending from behind the ocelli inwards and forwards, nearly touching the median line; another on either side in the broad conspicuous groove separating the vertex from the reflexed portion of the front; and, finally, the usual bent one, extending inwards from the gena. Below, the face is brown, darkest near the upper and lateral margins. The striations of the front are darker, and the dark lines thus formed extend back on the cheeks.

Thorax. Pronotum green, anterior and lateral margins concolorous with the head. Scutellum light green, transverse impression small, a white median longitudinal line being generally present. Beneath brownish green, the lateral edges of the pleurites with a black line which is the continuation of the darkened border of the head. Legs greenish, with spurs on femora, tibiæ, and tarsi brown or black. Elytra green unicolorous. Wings hyaline.

Abdomen. Above black; sides yellow; beneath green.

Our most common species, and widely distributed. The females differ greatly from the males in the length of the head.

T. noveboracensis Fitch.

Aulacizes noveboracensis Fitch, Cat. Ins. N. Y. State Cabinet, p. 56.

Green; form, size, and general appearance of *T. mollipes*, but with four conspicuous black spots on the front margin.

Length 12 mm.

Head shorter than in *T. mollipes.* Above yellowish green, marked with black as follows: a large black spot on the front margin on either side of the tip; another on the genæ above, just before the eyes; the usual line from the anterior edge of the genæ, which, however, is soon bent forward, proceeding along the junction of the reflexed portion and the front; and, lastly, a smaller line parallel with the latter on the vertex. Beneath, the face is yellowish green, and the lower and anterior margins of the genæ are black.

Thorax. Pronotum green, anterior and lateral margins concolorous with the head, a median line white. Scutellum light green, transverse impression small, with a white median longitudinal line. Beneath, yellowish green, sometimes with a few black spots on the pleurites. Legs yellow, with terminal spurs of tibiæ and tarsal joints brown. Elytra unicolorous green. Wings hyaline.

Abdomen. Above black; sides yellow; beneath green.

Rather rare. From northern Illinois.

SUBGENUS II.

Vertex and frontal margin rounded. Markings on the vertex complex.

T. similis, n. sp.

Color light yellow, marked all over with fine brown lines and dots.

Length 7 mm.

Head. Above yellow, tinted with rosy, and marked with brown lines as follows: beginning at the base of the head, two parallel lines, close together, extend about half way to the front edge, then, making a regular curve, they pass backward and around the ocelli, making two or three angular bends, and then proceed directly forwards till they touch another pair of black lines bordering the large striated portion of the reflexed front. Eyes black at the ends. Tip of the front margin with a single round median black spot. Beneath reddish yellow, with brown lines on the striæ of the front. Cheeks with two reddish stripes extending from the ends of the eyes to the clypeus.

Thorax. Pronotum irregularly spotted with brown, except four broad bands of lighter,—one pair almost on the middle of the dorsum, and one pair lateral. Scutellum brownish, with three triangular black patches on the base, the middle one of which extends to the transverse furrow which is marked with a narrow black line; from this two lines extend towards the tip. Beneath reddish yellow, with a narrow brown line laterally. Legs yellowish, terminal spurs on tibiæ and tarsal joints brown. Elytra light yellow, finely marked with longitudinal brown lines. Wings brown.

Abdomen. Above black, with white lateral margins; beneath yellowish green.

Rare. Described from one specimen, taken at Bloomington in May, 1884. Quite similar in general structure to the succeeding species, but the simple sharply defined markings on the vertex, etc., seem to indicate true specific differences.

T. hieroglyphica Say. (Pl. III., Figs. 24–26.)

Tettigonia hieroglyphica Say, Journ. Acad. Phila., Vol. VI., p. 313, 6.

Color variable, generally reddish, sometimes slaty green, or even black, in varieties. Head and thorax with hieroglyphical black markings.

Length 8 mm.

Head. Above reddish, with variable black markings. These markings consist of a curved spot on the middle and base of the vertex, one between the ocelli and the eyes, one on the margin of the reflexed front, and a large median one on the tip of the vertex. These spots are variously connected by narrow lines, and other smaller spots may be present. Beneath, with light spots on the middle of the front and adjoining parts of the cheeks. Front generally marked with a black line around the striated part, striations brown or black. Clypeus with a large black median spot.

Thorax. Pronotum reddish, with numerous small black and white spots irregularly arranged. Scutellum variably marked, a broad central longitudinal band generally lighter. Black triangular spots about the middle of the sides of the base. Often a median black line present. Transverse striation black. Beneath, reddish spotted with yellow, and with two black spots laterally. Legs yellowish, terminal spurs on tibiæ and tarsal joints brown. Elytra reddish, often margined with white; sometimes also with many short longitudinal light lines.

Abdomen. Above black, with white lateral margins; beneath yellowish green.

A very common and extremely variable species. The two following varieties are very noticeable:

Var. *α*.

This variety differs from *T. hieroglyphica*, in being almost entirely slaty green, though possessing the same black markings. The median band of the scutellum is a beautiful bright yellow. The elytra have five black longitudinal lines. Body yellowish green beneath.

Var. *β*.

This variety is deep black in color, apparently due to the blendings of the black lines in var. *α*.; the specimens show a tendency to an obliteration of the slate-green markings and may become entirely black. The most persistent lines, which may indicate something of the original marking of the group, are a yellow line before the eyes, one on the cheeks nearest the base of the clypeus, and one just beneath the antennæ. The median band on the scutellum seems to become even brighter. There are also lines on the claval sutures of the elytra.

These remarkable varieties would probably have been ranked as distinct species if connecting links were not often taken.

SUBGENUS III.

Head very short, elytra apparently with an additional sector and no anteapical cells.

T. bifida Say.

Tettigonia bifida Say, Journ. Acad. Phila., Vol. VI., p. 313, 5.

Green; head and thorax transversely, and elytra longitudinally, lineate with black.

Length 6 mm.

Head. Above yellow, with a broad black band in which are situated the ocelli, and a conspicuous black tip. Eyes brown. Beneath black, with two small yellow spots, one on either side of the tip of the front margin. Sides of the front and tip of the clypeus, brown. The gulæ are margined with yellow, and the antennæ are yellow.

Thorax. Pronotum with the central part green, and, at the anterior and posterior margins, a double band of black and yellow,—the black being in front of the yellow. Scutellum small, black, margined with white. Beneath black, except the narrow pleurites of the prothorax, which are yellow. Legs yellowish, terminal spurs on tibiæ and tarsal joints brown. Elytra green, veins black or brown. Wings subhyaline, veins brown.

Abdomen black, anal segments yellow.

This is a very beautiful and quite common insect. It seems to differ so much from all others of the genus that a subgenus must be made for it. It is well distributed over the State.

SUBGENUS IV.

Head above, short, face very much elongate. Elytra without anteapical cells.

T. tripunctata Fitch. (Pl. III., Fig. 27.)

T. tripunctata, Fitch. Cat. Ins. N. Y. State Cab., p. 53.

Pale brownish yellow, lineate with brown. Head with three black spots above.

Length 5 mm.

Head. Above light brownish yellow, with a large black spot around both ocelli and one on the apex of the front margin; the striations of the reflexed portion are brown. Eyes marked with a brown spot. Beneath light brownish yellow, with a pair of brown lines on each side of the front, bounding the striated portion and converging till they meet on the clypeus. The cheeks are ornamented with two broad brown stripes.

Thorax. Pronotum light brownish yellow, with two transverse brown lines. Scutellum small, yellowish, with a central pale brown spot. Beneath yellowish, side pieces often bordered with lighter. Legs yellowish, terminal spurs on the tibiæ and tarsal joints brown. Elytra brownish yellow, veins black or brown. Wings subhyaline, veins brown.

Abdomen beneath, yellowish.

Rare in southern Illinois.

TRIBE II. GYPONINA.

GENUS IV. GYPONA.

Gypona Germ., Mag. d'Ent. Tome IV., p. 73.

Oval, flattened insects, about one cm. long by two or three mm. wide; generally green.

Head about twice as wide as long; anterior margin strongly, and the posterior but slightly, curved. Eyes, as seen from above, large, triangular, situated on the outer corners. Ocelli on the vertex, often on short tubercles. Vertex often longitudinally furrowed. Thorax about two and a half times as wide as long; the anterior and posterior edges about equally curved; lateral edges composed of two nearly straight portions, united at about one third from base in an obtuse angle,—the outer angle. The sculpturing consists of a series of nearly parallel transverse striations, sometimes interrupted anteriorly by a large scar. Scutellum triangular, the top-shaped tip generally marked off by a distinct suture. The whole scutellum is sculptured like the thorax, even to the large lateral anterior scars. Elytra with two veins on the clavum, the radial vein forked and the apical and anteapical cells variable according to the species. Wings hyaline. Abdomen with six segments in the male and five in the female. Beneath, the legs close together, increasing in size from before backwards.

I have seen five species of this genus from Illinios, four new. Two others have been described from this State; one by Uhler, the description of which I append, and the other by Sahlberg, which I have not seen.

The following table will serve to distinguish the five species that I know:

Not red above.
  Elytra white or light yellow.
    Head and thorax light yellowish.
      Thorax 8-lineate with red ....G. 8-LINEATA.
      Thorax bipunctate with black..G. BIPUNCTULATA.
    Head and thorax black...................G. NIGRA.

Elytra black, except the outer edge, which is whitish. .... G. ALBIMARGINATA.

Reddish all over the back .... G. BIMACULATA.

The insects of this genus are remarkably uniform, but the species are distinctly marked.

G. 8-lineata Say.

G. 8-lineata Say. Jour. Acad. Phila., Vol. IV., p. 340.

Green, with eight red or yellow lines on the thorax, which continue on the head and scutellum. Elytra with yellowish veins.

Length 10 mm.

Head. Above green, with the continuation of the reddish lines as follows: a middle pair, close to the median furrow, continuing nearly to the apex; the next pair represented only by small yellowish spots; while the third follows along the edge of the eye and the anterior margin of the head, the outer pair not being present. Beneath, the color is lighter than above, unicolorous, the front and clypeus not separated by a distinct suture.

Thorax. Pronotum very narrowly margined, disk finely striate, and with eight equal parallel reddish lines. Scutellum green, anterior portion with six reddish lines continued from the thorax, terminal portion transversely striate. Beneath, and legs, light green. Elytra uniform green, apical and anteapical cells irregular, numerous.

Abdomen unicolorous green.

The most common species of this genus.

G. bipunctulata , n. sp.

Green, unmarked, except by a black spot near the anterior edge of the prothorax on either side.

Length 10 mm.

Head shorter, and with slightly blunter anterior margin than in *G. 8-lineata.* Transverse striations visible on the front, and the lore distinct.

Thorax with the pronotum faintly transversely striate, with the usual scars, and also bipunctate with black. Scutellum with the usual scars and striations behind. Legs and under surface lighter. Elytra with five apical and four anteapical cells. Wings hyaline.

Abdomen unicolorous green.

Not so common as the preceding species.

G. nigra, n. sp.

Black above; margin of the thorax and the elytra yellowish green; beneath green.

Length 9 mm.

Head. Above without median groove, the surface irregularly striated, the striæ extending obliquely forward; color black; eyes, a narrow margin near them, a line extending forwards and inwards from the ocelli, and a spot near the posterior margin of the head, behind them, yellowish green. Beneath green.

Thorax. Pronotum black, with the lateral margins, and sometimes a spot on the anterior edge, green. Beside the usual lateral scar, there is a smaller additional one just behind it. Only the posterior portion of the disk striate. Scutellum black, with the corners yellowish green. Legs and under surface lighter. Elytra with five apical and four anteapical cells, color light yellowish green, semi-transparent.

Abdomen black above and green below.

G. albimarginata, n. sp.

Scutellum and elytra black; head, thorax, and edge of elytra greenish yellow. Beneath greenish marked with black.

Length 10 mm.

Head. Above, with a scar on either side near the base; color pale greenish yellow with the median groove and scars brown. Beneath yellowish green, with brown patches in the prominent frontal striations and on the genæ.

Thorax. Pronotum pale yellowish green, with the posterior border brown. Scars four, as in *G. nigra.* Only the posterior half of the disk striate. Scutellum black, with two brownish spots on either side near the front margin, and also, sometimes, a broad, shallow median groove, brown. Posterior part brown, with lateral edges yellowish white. Elytra black, outer margin with a very broad, and the inner margin with a very narrow, edge of light greenish yellow. Veins near the tip margined with brown.

Abdomen. Beneath yellowish, marked with dark brown or black; lateral pieces with a curved dash of brown, and the median pieces with the basal half or two thirds, black or brown.

G. bimaculata, n. sp.

Rosaceous, head and anterior portion of the thorax greenish. Eyes, ocelli, and a small discal spot on elytra black.

Length 10 mm.

Head shorter than usual. Above, with the median groove represented by a black line, eyes and ocelli deep black, conspicuous. Beneath paler green; the upper edge of the genæ acute, black; antennæ black.

Thorax. Pronotum reddish, anterior part green and not striate. Scutellum finely and irregularly striate, reddish; posterior portion marked off by a narrow brown line and a coarsely granulated brown patch on either side, near the anterior corners. Elytra rosaceous, with a small conspicuous black spot near the middle. Wings brown, veins black.

Abdomen, beneath, green.

A beautiful species, also rare.

G. cinerea Uhler.

G. cinerea Uhler, Bull. U. S. Geol. Surv., Vol. III., p. 460.

I have not seen this species, but as it was described from Illinois I copy the original description:

"Aspect of *Philænus*, short, dark cinereous, more or less tinged with yellow. Head long-semilunate, angular at tip, and with the tip recurved, black; vertex flat, coarsely punctate with black, a little pubescent, impressed behind the apex generally with a short, impressed, longitudinal line, and each side with a longer one, or with simply indentations in their places; face irregularly dotted with piceous, and with a few punctures on the sides, the front convex transversely, more prominent above, triangularly impressed at base, sometimes with traces of transverse brown lines; cheeks broad, the outer ones oblique, a little expanded, and broadly rounded, very slenderly tapering on the apical half. Antennæ largely piceous, or banded with piceous. Pronotum transversely rugulose, pointed with fuscous, a little punctate anteriorly and near the sides, a transverse series of short, indented lines behind the forward margin, and with a bald patch in the place of callosities; lateral margins oblique, slanting beneath the middle of the eyes, the edge narrowly recurved; propleuræ dotted with fuscous, the meso- and meta-pleuræ pale, a little tinged with piceous on the disks. Legs pale brownish, or dull testaceous, dotted with fuscous; the coxæ clouded with fuscous, and the femora and tibiæ more or less piceous on the upper face, and the latter sometimes also on the under face; tarsal joints either black beneath or at the apex or with the last joint; nails and pulvilli piceous. Scutellum short, acute, minutely rugulose and punctate at base and in patches, minutely dotted with fuscous at remote, unequal intervals. Hemelytra very broad, and with the costal margin more arcuated in the female than in the male, and with the cells shorter and more irregular; the nervules thick, prominent, margined each side, throughout, with fuscous, impressed punctures; the costal edge thickened, a little recurved, the submargin punctate with fuscous; apical cells longer and less oblique-sided in the female than in the male. Tergum more or less black, and the venter black basally, or with the disks only of the segments before the apex black, or with all the segments simply punctate with fuscous. The surface is generally invested with minute, prostrate, yellowish pubescence."

Length to tip of hemelytra, 7–9 mm. Width of pronotum, 2.5–3 mm.

EXPLANATION OF PLATES.*

PLATE I.

Fig. 1.—Face of *Allygus irroratus* Say.
Fig. 2.—Face of *Agallia siccifolia* Uhler.
Fig. 3.—Vertex of same.
Fig. 4.—Antenna of *Oncometopia undata* Fabr.
Fig. 5.—Thorax of *Tettigonia mollipes* Say; ventral view.
Fig. 6.—Legs of *Oncometopia undata.*
Fig. 7.—Female generative organs of *Oncometopia undata*; ventral view.
Fig. 8.—The same; dorsal view.
Fig. 9.—The same; lateral view.

PLATE II.

Fig. 10.—Head of *Oncometopia undata;* dorsal view.
Fig. 11.—The same; lateral view.
Fig. 12.—The same; ventral view.
Fig. 13.—Elytra of *Oncometopia undata.*
Fig. 14.—Wing of same.
Fig. 15.—Head of *Aulacizes irrorata* Fabr.; lateral view.
Fig. 16.—The same; ventral view.
Fig. 17.—Elytra of *Aulacizes irrorata.*
Fig. 18.—Wing of same.

PLATE III.

Fig. 19.—Head and thorax of *Tettigonia mollipes* Say (female); dorsal view.
Fig. 20.—Head of *Tettigonia mollipes* (male); ventral view.
Fig. 21.—The same; lateral view.
Fig. 22.—Elytra of *Tettigonia mollipes.*
Fig. 23.—Wing of same.
Fig. 24.—Head and thorax of *Tettigonia hieroglyphica* Say; dorsal view.
Fig. 25.—Head of same; lateral view.
Fig. 26.—Head of same; ventral view.
Fig. 27.—Elytra of *Tettigonia tripunctata* Fitch.

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*These figures are all original camera lucida drawings made by the author.

PLATE I.

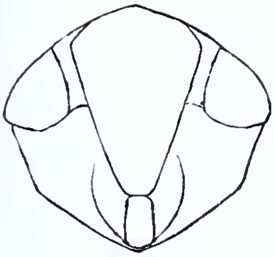


FIG. 1.

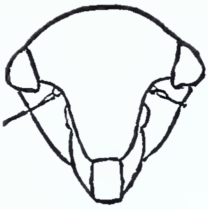


FIG. 2.

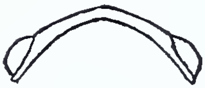


FIG. 3.

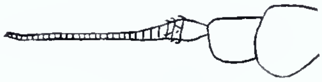
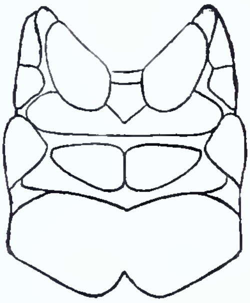


FIG. 4.



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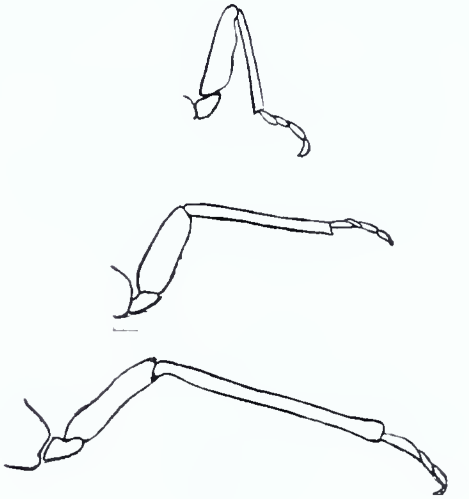
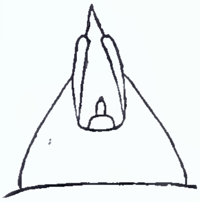


FIG. 6.



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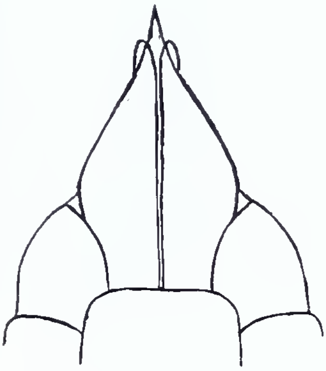


FIG. 7.

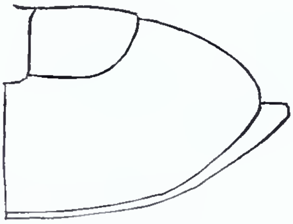


FIG. 9.

PLATE II.

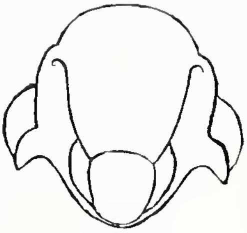


Fig. 12.

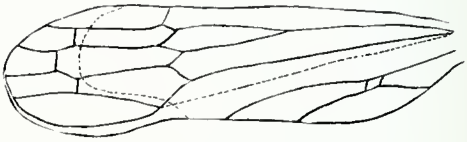


Fig. 13.

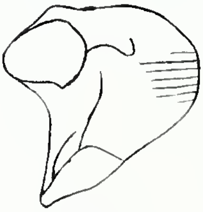


Fig. 11.

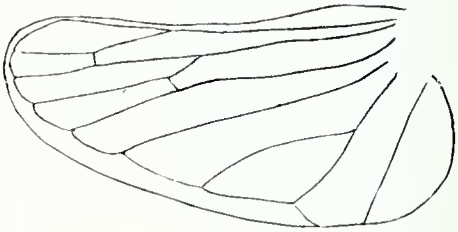


Fig. 14.

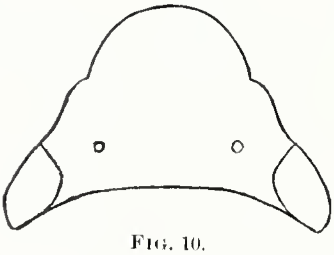


Fig. 10.

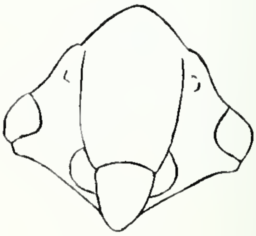
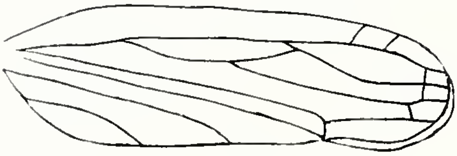


Fig. 16.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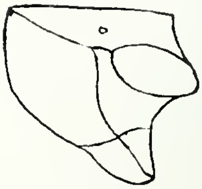
Fig. 15.

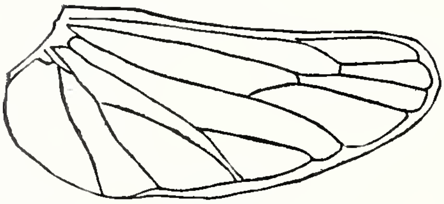
Fig. 18.

PLATE III.

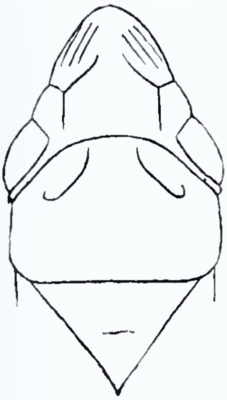
FIG. 19.

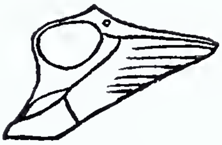
FIG. 21.

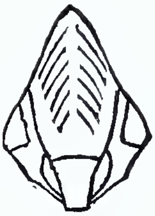
FIG. 20.

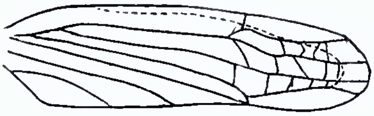
FIG. 22.

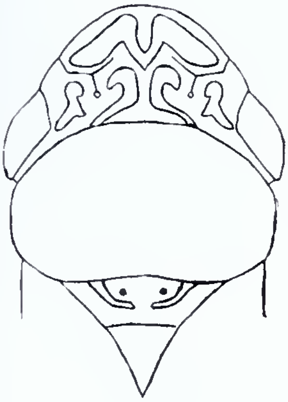
FIG. 24.

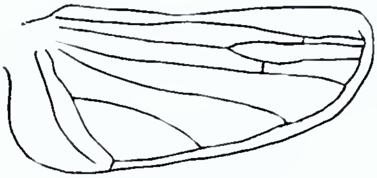
FIG. 23.

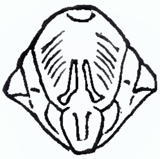
FIG. 26.

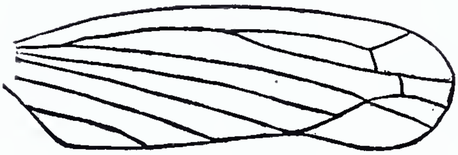
FIG. 27.

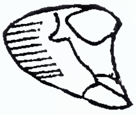
FIG. 25.

Article III. — *On the Parasites of the Lesser Apple Leaf-Roller, Teras minuta* (Robs.). By Clarence M. Weed.

In a paper to be published in the Report of the State Entomologist of Illinois for 1886, I have discussed at length the literature and life-history of the Lesser Apple Leaf-Roller, originally described by Robinson as *Tortrix minuta*, and since re-described by Le Baron, Riley, Packard, and Zeller under the specific names of *malivorana*, *cinderella*, *vacciniivorana* and *variolana*. I have there shown that the life-history of the species when feeding upon apple is the same as when feeding upon cranberry, Dr. Riley having proved that in the latter case the species is dimorphic, — there being a yellow summer form and a gray winter form. The parasites described below were mostly bred at the Laboratory during 1886, though a few had been obtained during previous seasons. It is a little remarkable that although this leaf-roller has been so often injurious both upon apple and cranberry, and has frequently been treated of in entomological literature, there has heretofore been recorded but one species of parasite bred from it, (obtained from cranberry-feeding larvæ). Yet from the frequently recorded fluctuations in the numbers of the larvæ upon apple, it seems probable that they have been subject to parasitic attack for many years.

I desire to acknowledge my great obligations to Professor S. A. Forbes, to whose liberal-minded policy of allowing his assistants personal credit for much of the work done by them, I am indebted for the opportunity of publishing the present paper; and to Dr. C. V. Riley, who has kindly determined the generic position of the species of *Limneria*, *Cremastus*, and *Pimpla* described below.

LIMNERIA ELEGANS, sp. n.

Cocoon.—Length 6 mm. White, thin, sub-cylindrical.

Imago, ♀.—Length, 4.5 mm. Black, somewhat shining; mandibles straw-yellow, tipped with brown; palpi, white; four anterior legs rufous, with coxæ and trochanters whitish, and tips of tarsi dusky; posterior legs rufous, with coxæ (except tips) and proximal portion of trochanters black, and tips of trochanters, together with apical portion of tarsi dusky; ventrum of abdomen pale yellow anteriorly and darker posteriorly. Antennæ a little more than half as long as body, piceous, except ventral surface of the two basal joints, which are yellowish. Tegulæ whitish. Wings with nervures and stigma dull yellowish brown, former pale at base, and latter with a pale spot on proximal portion; areola entirely wanting. Scutum and scutellum of metathorax finely aciculate. Scutellum of metathorax very finely granulate; carinæ only slightly developed anteriorly, wanting posteriorly. First joint of abdomen smooth and shining, suddenly enlarging transversely about two thirds of the way back, the remaining segments having the appearance of being very finely squamulate. Ovipositor nearly half as long as abdomen.

Described from two specimens. The only other American species that has been described under the genus Limneria, having no areola, is *L. rufipes* Prov. (Nat. Can., Vol. VI., p. 149), from which the present species differs in the color of the stigma, ventral surface of the abdomen, anterior coxæ, etc.

LIMNERIA TERATIS, sp. n.

Cocoon. — Length 7 mm. Thin, white, nearly cylindrical in form.

Imago, ♀. — Length, 6 mm.; alar expanse, 8 mm. Black; mouth parts honey-yellow; first pair of legs pale rufous; second pair of same color, except tarsi, which are whitish tipped with dusky; coxæ and upper part of trochanters of third pair of legs black, femora pale rufous tipped with dusky, tibiæ whitish at base, then an imperfect dusky ring, then whitish again, and tipped with a broad dusky ring, tarsi dusky, with whitish rings at the articulations; ventral surface of abdomen dull brown. Antennæ piceous, setaceous, two thirds as long as body. Tegulæ whitish. Wings subhyaline; nervures and stigma brownish black, the former pale at base, and the latter with a pale spot near where it arises; areolet petiolated. Scutum of mesothorax somewhat shining, finely granulate, with shallow punctures, and a faintly impressed longitudinal area on each side of the dorso-meson; very sparsely pubescent. Scutellum of mesothorax granulate, pubescent. Scutellum of metathorax granulate; carinæ prominent, so arranged as to enclose a sub-circular area on anterior dorso-lateral surfaces, a central pentagonal longitudinal area, the surface of which is transversely striate, and on each side of which there are two sub-triangular areas, with reticulated surfaces. Abdomen shining, with sparse, fine pubescence; first segment subcylindrical, enlarged posteriorly. Ovipositor nearly as long as abdomen.

Described from two specimens bred from *Teras minuta* in June.

Differs from *L. annulipes* Cresson in the larger ovipositor, and in the thoracic sculpture; and from *L. fugitiva* (Say) in its smaller size and black posterior coxæ.

PIMPLA MINUTA, sp. n.

Imago, ♂.—Length 5 mm. Black; tarsi, ventral surface of first two antennal joints, tegulæ and small spot just in front, first four legs (except tarsal claws of posterior pair and apical tarsal joint of middle pair), with trochanters of posterior legs, and ventrum of abdomen (except two dusky quadrangular spots on each segment), clear white. Posterior edges of middle abdominal terga whitish. Coxæ and femora of posterior legs pale rufous, latter tipped with black; posterior tibiæ white, with an imperfect dusky ring near base and a broad dusky ring at tip; first tarsal joint white tipped with black; second and third black, with white at base; the rest dusky throughout. Antennæ two thirds as long as body, setaceous, nearly piceous, the first two joints white beneath, and the under surface of the third, fourth, and fifth lighter than the rest. Wings hyaline; nervures and stigma brownish black, paler at base; areolet moderate, sessile, sub-rhomboidal. Scutum and scutellum of mesothorax pubescent, shining, with numerous shallow punctures; scutum with two oblique impressed lines arising anteriorly on each side of the middle and meeting on the upper surface. Scutellum of the metathorax canaliculate. First joint of abdomen shining, with a prominent ridge arising anteriorly on each side of the middle and running obliquely back; between these ridges in front the segment is excavated and the sides are also somewhat hollowed out. Remaining segments punctate, pubescent.

Described from one specimen bred from *Teras minuta* in June.

This is a well-marked species, easily distinguished from those previously described.

CREMASTUS FORBESI, sp. n.

Cocoon. — Length 6 mm. Thin, whitish, sub-cylindrical.

Imago, ♀ — Length 7 mm. Black; eye orbits, mouth parts, ventrum of abdomen, and two anterior pairs of legs, honey-yellow; posterior legs approaching a chestnut color, with tips of tibiæ dusky; tarsi dusky, especially at the tips; posterior margin of abdominal terga (except first) dusky yellow. Antennæ 5 mm. long, setaceous, ventral surface nearly tawny olive. Scutum of mesothorax punctate, with a faint impressed line starting a short distance each side of the middle of the anterior margin, and running slightly obliquely to the posterior margin, being united on the medio-dorsal portion of the scutum by a broad, flattened, thickly punctured area. Scutellum of mesothorax punctate, having (in the specimen at hand) an indistinct, transverse, chestnut-colored band. Metathorax strongly sculptured; a well-developed longitudinal carina on each side of the dorso-meson, arising near the anterior margin, and running to posterior margin, the two being connected anteriorly by a transverse carina; on the outside of each of these runs another longitudinal carina, the latter being connected with the former by transverse carinæ, so as to enclose a quadrilateral area on the dorso-lateral angles of the metathorax; another longitudinal carina on each side, below those last mentioned; a spot on the anterior margin each side of the dorso-meson shining, with scattered punctures; remainder of the dorsum transversely striate (between the carinæ); sides punctate. Wings hyaline; tegulæ straw-yellow; stigma of moderate size, dusky yellowish brown; veins straw-yellow at base, becoming dusky outwards. First abdominal segment shining, long, slender, slightly enlarged posteriorly; remaining segments pubescent. Ovipositor as long as abdomen.

Described from one specimen bred from *Teras minuta*, 13th June, 1886. Dedicated to Professor S. A. Forbes.

CLINOCENTRUS AMERICANUS, sp. n.

Cocoon.—Length 3 mm.; width 1 mm. Whitish, thin, without loose silk; usually formed within the cocoon of the host.

Imago.—Length, ♂ 1.7 mm.; ♀ 2–2.1 mm. ♂, ♀. Reddish or yellowish brown, with a black head, dark brown or piceous antennæ (except at the base), and more or less black on the dorsum of the thorax, especially at the margin, and the anterior and posterior portions of the abdomen. Legs honey-yellow, with tips of tarsi dusky. Mandibles brownish, tipped with black; palpi whitish. Ovipositor whitish tipped with dusky. Antennæ as long as body, basal joints testaceous. Wings subhyaline, tegulæ and basal portion of veins testaceous; middle portion of costa dusky; stigma and remaining nervures dull brownish white. Mesoscutum with sparse pubescence, smooth, except for two impressed oblique lines which form a V-shaped marking, the base of the V being on the medio-posterior portion of the scutum, and the side of the V extending cephalo-laterad. Mesoscutellum smooth, sub-triangular. Scutellum of metathorax reticulate. Tergum of first abdominal segment with front slightly excavated; longitudinally rugose; terga of two following segments finely rugulose. Ovipositor exserted, nearly as long as abdomen.

The male of this species is usually darker in color than the female and much more slender in form.

Described from many specimens bred from *Teras minuta* in June.

I propose the above specific name for this species, because it is, I believe, the first insect of the genus to be described in America.

APANTELES CACŒCIÆ Riley.

As I have elsewhere noted*, a single specimen of this species was bred from *Teras minuta* during May, 1886.

MACROCENTRUS DELICATUS Cresson.

Professor Riley has recorded† the breeding of this species from the second brood of larvæ of Teras feeding upon cranberry in New Jersey.

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*Notes on some Illinois Microgasters. Bull. Ill. St. Lab. Nat. Hist., Vol. III., Art. I., p. 5.

†U. S. Dept. Agr., Div. Ent., Bull. 4, p. 25.

ARTICLE IV.—*On the Anatomy and Histology of a New Earthworm* (*Diplocardia communis*, gen. et sp. nov.). By H. GARMAN.

CHARACTERS OF THE GENUS.

Vasa deferentia opening to the exterior behind the clitellus by two apertures on the ventral side of somite 19. Two copulatory fossæ extend from the middle of the ventral side of somite 18 to the middle of the ventral side of somite 20, each fossa with a pair of long, curved setæ and an outlet of a prostate gland at its extremities. Internal apertures of the vasa deferentia two pairs; one pair in each of the somites 10 and 11. Seminal vesicles in somites 9, ?10, and ?11. Testes in somite 12. Spermathecæ in three pairs, one pair in each of the somites 7, 8, and 9. Ovaries flabelliform, situated in somite 13. Internal apertures of oviducts in somite 13; external apertures in somite 14. Setæ arranged in four double longitudinal series on the ventral side of the body, each somite bearing four pairs. Œsophagus very short, without calciferous glands. A muscular gizzard in somites 6 and 7. Typhlosole a very slight dorsal fold. Dorsal vessel double, consisting of two tubes fused only at the dissepiments. No subneural blood vessel present. Nephridia tubular, with the nephridiopores in line with the dorsal setæ of the external pairs; internal aperture in the somite preceding that in which the gland lies. Brain small, transversely elongated, with slight median anterior and posterior excisions. Præstomium not completely dividing the integument of the first somite.

The genus is based upon a large cylindrical flesh-colored species which is common in the black soil of Illinois prairie-land. Its body is made up of from 123 to 165 somites, and reaches a length of a foot. The following account of its anatomy will furnish the means of distinguishing it from other species of the genus which may be discovered.

The Form and Exterior.

The body is, for the greater part of its length, perfectly cylindrical in shape, there being none of the flattening of the posterior ventral region observable in species of Lumbricus. It increases gradually in diameter from the præstomium to somite 7, where it is thickest, then gradually diminishes to somite 11, posterior to which the diameter remains constant (not considering the clitellus) until a short distance from the posterior extremity, where it abruptly descends, the decrease being confined to about six very short terminal somites.

A few of the first somites are shorter than those which follow, but the maximum of length for these divisions of the body is reached at about somite 7; behind this somite is a gradual decrease in their length, so that at the middle of the length of the body somites are only half as long as the longest, and at the posterior extremity they are less than a third of the length of anterior somites. Impressed encircling lines divide the surface of the integument into numerous small false segments, and render the limits of the somites difficult to distinguish until the disposition of these lines is known. Somite 1 is without encircling lines, and its surface is plicated longitudinally. Somite 2 shows the plication on its anterior half, and also lacks the lines. The surface of 3 is devoid of wrinkles, but shows a single very faint encircling line. Somite 4 shows a distinct nearly median line and a faint anterior one. Somite 5, like most of those following, is encircled by two lines dividing its integument into three false segments, of which the median is smallest. Towards the posterior end of the body the lines disappear, about a dozen short terminal somites lacking them, and a few preceding these having a single one.

The mouth is a transverse slit, bounded below and at the sides by a fleshy lip — the anterior edge of somite 1 — and above by the præstomium. The latter is of the usual shape, has a perfectly smooth surface, and by its narrowed posterior portion reaches the middle of the dorsal wall of somite 1. Wrinkles sometimes continue its lateral boundaries and give it an appearance of completely dividing the integument of the first somite. The vent is terminal and vertical in position; the integument about it is faintly plicated.

The Setæ.

Four double longitudinal rows of setæ with distances between adjacent rows nearly equal, are disposed along the ventral face of the body. Each ordinary somite, therefore, bears eight setæ in four pairs. In sections, the two inner pairs of setæ are seen to be a little farther apart than each inner pair is from the outer pair of the same side. A line drawn through the middle of a somite at right angles to its vertical axis, would touch at its extremities the outermost seta of both outer pairs. The setæ are thus confined to the ventral half of the body. Setæ are lacking upon somite 1 and upon the three or four terminal posterior somites. They are of the usual form, but are rather slender. The distal extremity is bent a very little, and is obtusely pointed; the proximal end is bluntly rounded; the angulate swelling at the proximate end of the distal third is inconspicuous. In place of the inner pairs of ordinary setæ, on somites 18 and 20 are pairs of long uniformly curved copulatory setæ. On somite 19 the two inner pairs of setæ are lacking.

The Dorsal Pores.

The first dorsal pore is situated between somites 10 and 11. These openings are elliptical in outline, and are transversely placed. They may be obliterated in alcoholic specimens by the contraction of surrounding tissues, but in worms killed in corrosive sublimate they can be readily studied.

The Clitellus.

The clitellus does not appear until the worms are nearly grown, when the somites which will eventually bear the glands assume a dull yellow color, but are not swollen beyond the common outline. In large examples collected during the month of May the clitellus is well developed. It is of a pale flesh color, projects beyond the common outline a little, and occupies the walls of somites 13 to 18 inclusive. Its surface often presents peculiar fissures, which appear as if made by passing the edge of a knife blade over it; the encircling rings are obliterated on the gland-bearing somites. In some cases the gland is developed only on the posterior part of the wall of somite 13, and it is generally less developed on this somite than on those which succeed it. It is not developed over a narrow median ventral area between the two inner rows of setæ. The lateral edges of this area are sinuous, from ingrowths of the gland between each two pairs of setæ. The area begins to widen towards the front on somite 14, and towards the rear on somite 17.

THE EXTERNAL APERTURES OF THE GENITAL ORGANS.

The external apertures of the three pairs of spermathecæ show very clearly in examples killed in corrosive sublimate, at the anterior edges of somites 7, 8, and 9, opposite the interspaces between the setæ of inner pairs on the same somites. The openings are upon minute transversely-placed prominences.

The external apertures of the oviducts are two minute pores, very close together, within and a little in advance of the two inner pairs of setæ on the ventral side of somite 14. In many examples the surrounding integument is a little elevated, producing a low transversely-elongated mound bearing the apertures at its summit.

Two copulatory papillæ are usually present on the posterior edges of somites 17 and 20, one opposite each inner pair of setæ of these somites. In most cases these are the only papillæ present; but in one example seen, there were besides the pair on somite 17, four pairs on somites 20, 21, 22, and 23, respectively. In still other examples a pair was found on each of somites 16, 17, 20, and 21.

At about the middle of somite 18, at the points at which the pairs of copulatory setæ appear, are the anterior ends of two shallow copulatory fossæ shaped like parentheses, but with the convex sides towards each other. These grooves extend across somite 19 and terminate on somite 20, where also copulatory setæ appear. No apertures of sexual organs can, by ordinary means, be perceived in this region; but on cutting out the body-wall and studying it with a microscope, the aperture of the duct of a prostate gland will be found in the two extremities of each fossa, one opening, thus, beside each pair of copulatory setæ on somites 18 and 20. The vasa deferentia open on two very small papillæ, one in each fossa near the middle of somite 19. The vasa are in no way connected with the prostate glands. Between the fossæ the body-wall is a little impressed, and forms here a shallow basin.

THE DISSEPIMENTS.

No dissepiments are present, apparently, between the four most anterior somites. The first developed partition separates somites 5 and 6. It is much thinner than the five succeeding ones. The latter are greatly thickened from the unusual development within them of muscle fibers. These six anterior dissepiments, and to some extent those immediately following, project backwards from the line of attachment to the body-wall, so that anterior septa are received into succeeding ones, and the part of the alimentary canal belonging in one somite may be carried back into another. Cross sections from this region are sometimes puzzling on account of this. Posteriorly the dissepiments grow thinner and more transparent from loss of their muscular character, and in the greater part of the body are reduced to delicate films. The aperture in each septum beneath the alimentary canal is circular in outline, and reaches from the ventral side of the canal to the body-wall. Through these apertures pass the ventral blood vessel and the ventral chain of nerve ganglia.

THE ALIMENTARY CANAL.

The pharynx extends from the mouth to about the beginning of the fourth somite. It is of the usual character, consisting of a thin-walled sac with numerous bands of muscle extending from its outer surface backwards and outwards to the body-wall. When it is empty, its walls are extensively infolded, producing an irregular longitudinal plication of its inner surface.

At the posterior end of the pharynx, the dorsal wall of the canal presents a narrow transverse inward fold. Behind the fold the caliber abruptly increases again with no change in the character of the walls. This region of the canal is the only part that can be considered an œsophagus. The exterior is devoid of muscular bands and the walls are thin and distensible. There is no trace of calciferous glands. The œsophagus, if such it can be termed, is ordinarily crowded into a very narrow space and on casual observation may escape notice as a division of the canal. It may be doubled over the next division.

Within somites 6 and 7 the walls of the canal become greatly thickened by a development of circularly arranged muscle, and form a powerful grinding apparatus,—the gizzard. Exteriorly this region is noticeable from its pearly lustre and unyielding walls. It really consists of two divisions, belonging in somites 5 and 6, respectively, but the backward extension of the septa brings the anterior part within 6 and the posterior part within 7. The line of attachment to its wall of the septum between 5 and 6 indicates the line of separation of the two divisions. This separation is narrow but complete, the wall of the intervening region being thin, and lacking the circular muscle fibers. Longitudinal sections of the gizzard show each part to consist of a zone of muscle which is thickest at its middle, and diminishes in thickness, somewhat, anteriorly and posteriorly. The anterior division of the gizzard is the larger; both divisions decrease a trifle in diameter from before backwards.

The first division of the intestine is the most slender portion of the alimentary canal. It is cylindrical, with smooth and rather firm walls, with a gradually increasing development of chloragogue cells from before backwards, the posterior third becoming dark brown in color from the abundance of these cells. It extends from the gizzard to somite 17, terminating after passing through the partition between 16 and 17. The epithelial lining of this division of the intestine is closely corrugated.

Within the posterior part of somite 17 the canal at once expands, loses the chloragogue cells, and becomes thin-walled. This forms the beginning of a second division of the intestine, the largest in caliber of all, extending through somites 18 and 19 and terminating in somite 20, where begins the third division.

The third division of the intestine extends from somite 20 nearly to the posterior end of the body. It is similar to the preceding more inflated part, being thin-walled and sacculated, and is pretty uniform in diameter throughout.

Towards the vent the canal again changes in character to form the rectum. Exteriorly there is little to distinguish this division from the intestine which precedes it, but cross sections show a decided thickening of the wall, due to an increase of muscle tissue and to the great development of the lining epithelium.

No intestinal cœca have been observed.

The typhlosole might easily escape observation on casual study. It is represented by a low ridge projecting into the cavity of the intestine from the dorsal side and extending from somite 23 backwards. It begins to decrease in size behind somite 40, and soon becomes scarcely perceptible.

THE VASCULAR SYSTEM.

The vascular system of this genus differs from that of Lumbricus in being simpler,—the subneural vessel and the commissural vessels putting the latter in communication with the dorsal vessel being here wanting. With certain of the post-clitellian group of genera, Diplocardia shows marks of closer relation with respect to these vessels.

The dorsal vessel is distributed upon the pharynx in the usual manner. From the pharynx it extends backwards over the gizzard as a simple tube without branches until just before the dissepiment between somites 6 and 7, where very small lateral branches pass around the posterior part of the gizzard and enter the subintestinal vessel below. Immediately behind the dissepiment between somites 6 and 7, the dorsal vessel divides into two trunks, which again unite to pass through the dissepiment between somites 7 and 8. In somites 8 and 9 the same thing occurs, accompanied by an increase in the size of the dorsal vessel and its lateral branches. In somites 10, 11, and 12 the lateral branches become greatly enlarged, equaling in diameter the dorsal vessel in these somites. All these "aortæ" are loosely bound to the posterior septa of the somites in which they lie, by very thin mesenteries. They are not closely bound to the intestine, as sometimes represented in figures of other earthworms, but give abundant space within for the distension of the intestine with food, and are therefore not themselves liable to be disturbed by the operations of digestion. Posterior to somite 9, the divisions of the dorsal vessel are not widely separated as they are in somites 7, 8, and 9; but the double character persists, and cross sections show that there are two completely separate tubes, at least at the middle of the somites, throughout the remainder of the body. Possibly in some cases the tubes do not unite to pass through the septa, since the channel between them may reach the septum and seem to continue the division through it. The dorsal vessel reaches its maximum diameter in somite 14. Anterior to this somite the vessel gradually decreases in size; posterior to it the vessel is for some distance about equal in size to the anterior division of the intestine, which it overlies and conceals. In somites 14–19 there is a sudden increase in the size of the vessel. Posterior to somite 19 the vessel is a little smaller, and continues quite uniform in diameter (with a very gradual decrease in size) to its termination at the posterior end of the body. In somite 13 the walls of the vessel show a few chloragogue cells when examined with a hand lens. Anterior to this somite the vessel is devoid of this gland. Posterior to somite 13 the vessel is thickly coated with the cells.

No free lateral branches are given off from the dorsal vessel in somite 13, but in all the somites following, two slender, contorted lateral branches pass off, one on each side, just before the posterior septum, and, like the aortæ, are bound to the dissepiment by a delicate mesentery. The pair in somite 14 reach the body-wall between the outer and inner pairs of setæ, and without branches pass into the integument. Those in succeeding somites divide into several branches just before reaching the body-wall, some of which doubtless collect the blood from the segmental organs and other structures, but most of them seem to emerge from the integument. In living worms the branches in adjacent somites may be seen to anastomose with each other and to ramify extensively in the body-wall. A vessel of unusual size collects blood from the clitellus

PLATE II.

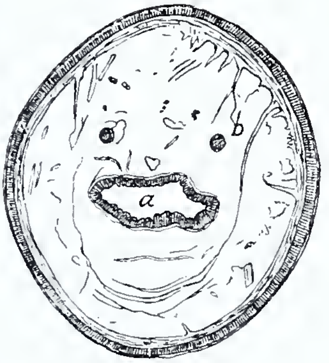

Fig. 4.

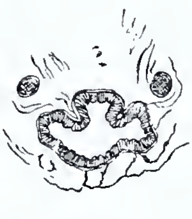

Fig. 5.

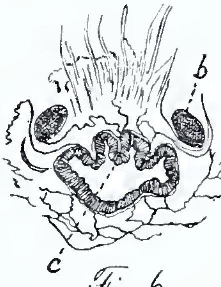

Fig. 6.

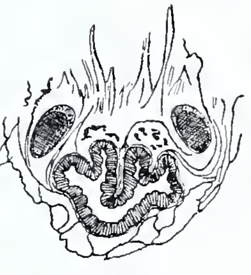

Fig. 7.

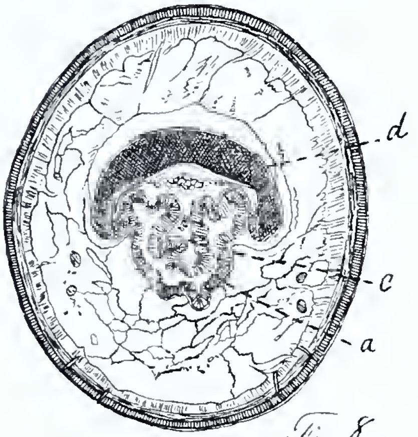

Fig. 8

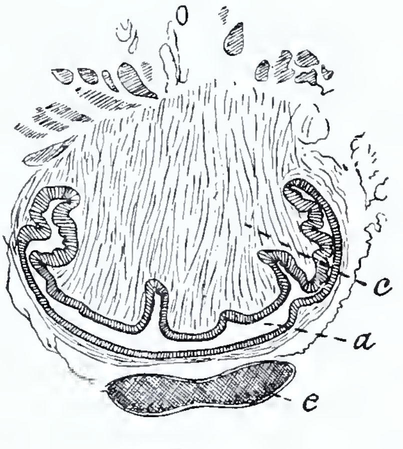

Fig. 9.

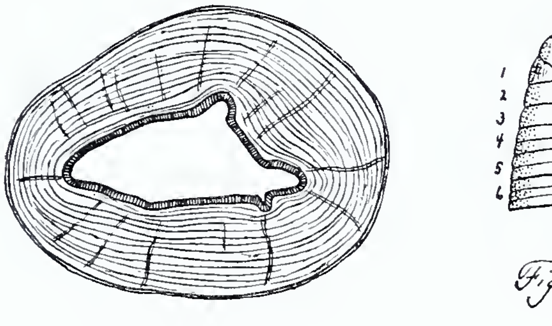

Fig. 10.

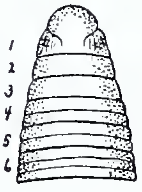

Fig. 11.

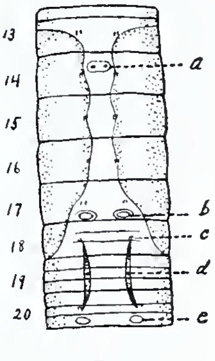

Fig. 12.

and joins the lateral vessel of each side in somite 18. All these lateral branches are, like the posterior part of the dorsal vessel, thickly covered with the brown chloragogue cells up to the point at which they pass into the body-wall. They are highly elastic, and after being stretched forward to their full extent during systole of the portion of the dorsal vessel to which they are attached, at once become contorted, or partly coiled, when the dorsal vessel again relaxes. The relatively thick chloragogue coating renders them conspicuous objects, although the blood vessel proper is generally very small. From first to last they are free from the alimentary canal.

The minute gastric branches reach the dorsal vessel a little before the middle of each somite. A close capillary network may be seen in the walls of the intestine, which in some of the anterior somites assumes the form of longitudinal sinuses.

The subintestinal blood vessel is slung by a mesentery from the ventral median line of the alimentary canal, and lies above the ventral nerve chain, passing along the dorsal side of the apertures in the dissepiments. By the dissepiments it is at regular intervals held near the ventral median line of the body, but in the cavities of the somites lies free in wide loops which extend from side to side. A pair of branches is given off before each dissepiment. It is smaller than the dorsal vessel, consists of a single tube, is non-contractile, and is not coated with chloragogue cells.

THE GENITAL ORGANS.

Three pairs of spermathecæ are present in Diplocardia. They occur in somites 7, 8, and 9, increasing a little in size from before, are pyriform in shape, with corrugated outer surface when not distended with spermatozoa, and each sends a rather thick duct through the body-wall, near the anterior septum, opening, as has already been noted, opposite the inner pairs of setæ. Each sac is provided with a small reniform cœcum, closely attached to one side at the point at which the duct leaves the receptacle. They are rather large, sometimes extending up along the sides well towards the dorsal vessel.

The shape of the cœcum varies occasionally, and may be cut up into irregular lobes. Quite frequently the receptacles are carried through the aperture in the lower part of a septum, and appear in a somite to which they do not belong.

Attached to the anterior face of the dissepiment, between somites 9 and 10, is a large, white, irregularly-lobed mass on each side of the alimentary canal,—the seminal vesicles. No lobes or ducts from these vesicles, passing through the septum, have been found, and no means of communication between the vesicles and the other male genital organs have been noted. It is possible, however, that in some conditions of these organs such lobes or ducts may exist, or, possibly, such communication may be by means of pores through the dissepiment. In worms more than half grown somites 10 and 11 are always found loosely filled with spermatozoa. These loose masses may have an extremely delicate membranous covering and represent lobes of the seminal vesicles, but no trace of such membrane has been seen either in sections or by the ordinary means; and it seems safe to assume that these somites are used simply as reservoirs for the temporary storage of the male element. In somite 12, on each side of the intestine, is a large white mass consisting of numerous berry-like lobes, the whole attached by a small area to the posterior side of the dissepiment between somites 11 and 12. Often they embrace the intestine and meet above it. These have been regarded as the testes because an examination of their contents shows them to contain the spermatozoa in various stages of development. No means of communication between these bodies and the somites in front of them has been observed, but doubtless the matured product is discharged through the septum to which the testes are attached. The spermatozoa are certainly not set free in the cavity of the somite in which the testes lie.

The vasa deferentia receive the spermatozoa by two pairs of large flared openings, one each in somites 10 and 11. They lie upon the floor of the somites, within the nephridia, one on each side of the nerve ganglia. The vasa deferentia, passing from them, at once plunge into the integument and become embedded in the thick inner layer of muscle of the body-wall. The vasa of each side soon meet, and thence continue side by side towards the outlet in somite 19. They lie just outside the outer seta of the inner pair, are perfectly cylindrical, a little contorted, and gradually approach the exterior, so that at the point at which the ducts of the first pair of prostate glands pass to the exterior, the vasa are at the middle of the muscular layer in which they are embedded. Just before turning outwards to their outlet in somite 19, they unite, and thus open by a single duct in the copulatory fossa, as already noted. From their position in the muscle layer, they cannot be traced by the methods of ordinary dissection, and it was only by cutting serial sections that they were finally traced to the external outlets.

Four peculiar glands, doubtless the homologues of what have been named *prostate glands* in other genera of Oligochæta, still remain to be described as a part of the male reproductive apparatus. In Diplocardia they have no direct connection with the vasa deferentia, but the products of both are discharged into the copulatory fossæ, and thus the same result is probably attained as would be by the passage of the vasa into the glands. Each gland opens by a separate duct at one end of a fossa. The glands are long, strap-shaped, orange-yellow bodies, floating for the greater part of their length free in the somatic fluid, so that they often pass by the apertures of the dissepiments into somites other than those in which they belong. They are abruptly bent where attached to the floor of the somites in which they open, and a large muscular duct arises near this end of the gland and penetrates the integument to the exterior. Each duct is accompanied by a pair of long copulatory setæ, occupying the place of the inner pairs in somites 18 and 20.

Excepting the form of the ovaries, the female genital organs of this genus are not especially different from those of Lumbricus. The ovaries are attached to the posterior face of the septum, between somites 12 and 13, and thus lie in the latter division of the body. They consist of rather large fan-like sheets of tissue, narrowing to a thick pedicel by which they are fastened to the septum, and under the microscope are seen to be made up of numerous parallel series of ova, growing more and more mature towards the free edges of the sheets. The whole structure is folded upon itself in an irregular fashion, and its free edges may be very ragged from the tearing apart of the extremities of series of ova.

The oviducts may be found posterior to and opposite the ovaries in somite 13. Their free internal portions are trumpet-shaped structures having, when under the microscope, the appearance of a miniature calla lily. Behind the flared internal aperture the ducts are narrowed, and, passing through the dissepiment between somites 13 and 14, penetrate the body-wall in the anterior part of somite 14.

THE NERVOUS SYSTEM.

The cerebral nervous mass is very small as compared with that of Lumbricus and Allolobophora, and is correspondingly simple. It lies upon the pharynx, in somite 2, and is a slender, transversely elongated body, with a slight median anterior and and posterior impressed line of division between the two fused ganglia composing it. Its greatest diameter is less than a fourth of its length. As it lies in position it forms an arch, with the convex side posterior. Its surface is perfectly smooth, and no nerves arise from it except two large cords which supply the region about the mouth and arise one at each of its outer extremities. Numerous small white cords which are liable to be mistaken for nerves arise from its dorsal and ventral posterior surfaces, and extend posteriorly towards the skin, but their iridescence in sunlight shows them to be small bands of muscle.

Strong commissures extend obliquely down the sides of the pharynx from the extremities of the brain to the subpharyngeal ganglia in somite 3. A little ventrad of the brain each commissure gives off from its anterior edge a large nerve which extends forwards along the pharynx, parallel with the nerve arising from the extremity of the brain. Two other small cords also arise from the anterior edge of each commissure; one near the ventral end of the dorsal third of its length, the other near the dorsal end of the ventral third. The commissures gradually expand as they approach the first ventral nervous mass, their inner edges with the anterior edge of the mass forming a gothic arch. From the expanded ventral part of each commissure is given off a fourth small nerve.

The first ventral nervous mass is depressed, and subtriangular in shape. Three large nerves arise from each side, and soon meet in one large strand. Their ultimate distribution has not been followed out. The ganglia posterior to the first are elongated elliptical, depressed masses, with strongly convex dorsal surface, and with no outward trace of division into two masses. The portions of the chain between the masses are very short, and show a slight median longitudinal impression as the only indication of a division into two cords. As the somites shorten towards the posterior end of the body, the nervous masses also become less elongated, and at the same time are brought closer together, the chain in the posterior part of the body being finally a succession of rounded swellings, with no interspaces. In the anterior somites each mass gives off from near its middle two large nerves on each side. They are directed forward and outward, and by large branches penetrate the body-wall. Other branches given off from them doubtless supply the viscera. Near the anterior limit of each mass a small nerve passes outward and forward on each side to the anterior dissepiment of the somite in which the mass lies. Ganglia forming the posterior part of the chain give off only one pair of nerves. The posterior mass (possibly representing several fused pairs of ganglia) gives off three pairs of nerves. From its middle pass out the two ordinary nerves. Posterior to these the mass becomes narrowed and gives off two small nerves, which extend outward and backward. From its posterior extremity a third pair of large nerves diverge and extend backward toward the integument in the region of the vent.

The Nephridia.

A pair of tubular segmental organs, similar to those of Lumbricus, occurs in most of the somites of the body. The internal apertures of these organs are in line with the outer setæ of the inner pairs, each aperture appearing in the somite preceding that in which its gland lies. The tube which passes through the septum from the aperture is small at first, but rapidly increases in diameter, and passes outwards and upwards along the inside of the body-wall. Outside the outer pair of setæ the tube is abruptly bent and returns upon its course until within the outer setæ; then turns outwards again and extends about half as far as in the first loop; returns again upon its course; and finally, as a slender tube, passes down within the mesentery which holds the gland to the body-wall, and reaches the latter in front of the dorsal seta of the outer pair. In specimens prepared according to Semper's "dry method," the nephridiopores show very clearly at the anterior edge of each somite, in line with the outer setæ. There seem to be no pores in somites 1 and 2.

All the specimens of Diplocardia thus far examined have shown the external apertures of the vasa deferentia on somite 19, and hence behind the clitellus. If we follow M. Perrier's classification rigidly, we must, therefore, place this genus in the group *post-clitelliani.* The position of the male pores so near the posterior limits of the gland would seem to indicate an intermediate position for the genus, and other features of its anatomy apparently confirm this impression by pointing to relations with genera in both the divisions *intra*-and *post-clitelliani.* Thus, of the fourteen characters of the genus Microchæta, one of the *intra-clitelliani*, given by Mr. W. B. Benham,* five (2, 4, 6, 10, and 14) are, in essentials, common to the two genera, while as many more points of likeness could be selected which as clearly indicate a relation of the genera. M. Perrier's genus Anteus, another of the *intra-clitelliani,* also bears some resemblance to Diplocardia. In both, the nephridiopores are in a line with the dorsal seta of the outer pair; the anterior septa are thick and muscular; the setæ are disposed in four double, longitudinal rows, and the gizzard is anterior in position. Recognizing M. Perrier's divisions as good, we may consider these resemblances to indicate an inferior position for our genus. The lower forms of a group often combine in themselves characters distributed in a number of higher forms, and this we may suppose to be the case with Diplocardia. At any rate its double heart, simple nervous system, the absence of a subneural blood vessel, together with its sluggish habit, mark Diplocardia as of low rank, and give us additional reason for placing it in the lowest of the three recognized groups.*

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* Quart. Jour. Micr. Sci., N. Ser., No. CII., 1886, p. 291.

The two genera of *post-clitelliani* with which Diplocardia has most in common are Acanthodrilus and Digaster, belonging to Dr. Claus's family Acanthodrilidæ. With Acanthodrilus the genus here described agrees in the position of the nephridiopore, in the possession of four groups of modified setæ, in having four prostate glands, in the character and forward position of the gizzard, and in the character of the spermathecæ.

Of the three species upon which M. Perrier based the genus Acanthodrilus he says: "Leur caractère le plus saillant, celui qui frappe tout d'abord, c'est l'existence de quatre orifices génitaux mâles au lieu de deux. Par chacun de ces orifices, on voit sailler un faisceau de soies courbes, d'aspect nacré, tres-longues et plus ou moins rétractiles, sans l'etre toutefois d'une manière complète. Chacun de ses faisceaux constitue un véritable pénis." In Diplocardia there are only two external openings for the sperm ducts, and these are not upon the somites upon which the pairs of prostates open (18 and 20), but upon the intermediate somite (19). They do not pass into the prostates and discharge the sperm through the ducts of the latter, but can be traced from the somites in the anterior region of the body, where they open into the body cavity as two separate tubes, lying side by side in the inner muscle layer of the body-wall until just at the external aperture, where they unite in one tube. The apertures are not accompanied by setæ of any kind, the inner pairs of setæ being wanting on somite 19. At the apertures of the ducts from the prostate glands on somites 18 and 20 are long, gently and uniformly curved setæ, one *pair* for each of these ducts. They occupy the position ordinarily occupied by inner pairs of setæ, lie close together, are perfectly smooth, very slender, and are capable of complete retraction, no trace of them being commonly perceptible from without. These probably represent the modified setæ of the prostate glands in Acanthodrilus, in which genus they are described as projecting fasicles of ornamented and more or less retractile setæ. The muscular duct of the prostate, with its accompanying setæ, does not, therefore, as in Acanthodrilus, constitute "un véritable pénis," the secretion of the prostates being in Diplocardia discharged independently of that of the seminal vesicles. This complete separation of the two sets of glands calls for another arrangement by which the secretions may be mingled, and this we have in the copulatory fossæ and the relations of the apertures of the various ducts to them. (See figure.) Another difference between the two genera is in the number of spermathecæ: Diplocardia has three pairs, one each in somites 7, 8, and 9, while Acanthodrilus has two pairs, one each in somites 8 and 9. With regard to the subneural blood vessel of earthworms, Mr. W. B. Benham (loc. cit.) says, "There is a sub-neural trunk in all forms, except Perichæta, Pleurochæta, Pontodrilus [and Microchæta]." From this we must infer that Acanthodrilus possesses this trunk; but in Diplocardia it is wanting, as are also the supraneural vessels. In the imperfect œsophagus of Diplocardia we may perhaps find still another differerence. This division of the alimentary canal is represented in Mr. Beddard's figure of *Acanthodrilus layardi* as a slender tube rather longer than the pharynx. It is represented as longer than the pharynx also in M. Perrier's *A. ungulatus.* Finally, the two genera differ in the character of the dorsal vessel. Some species of Acanthodrilus have been described as having the dorsal trunk divided in a few of the anterior somites, but in no description which I have seen has mention been made of a dorsal vessel made up of two tubes throughout its length, as in the case in the genus here described. Notwithstanding these differences, Diplocardia seems to the writer to be more closely related to Acanthodrilus than to Digaster. The position of the nephridiopores opposite the inner pairs of setæ, and the two muscular gizzards in the latter genus, render it very distinct from either of the others, and makes a comparison with Diplocardia unnecessary. The species of Acanthodrilus have been obtained from the East India Islands, from Madagascar, and from South Africa. It is a matter of some interest, therefore, to find in this part of the world a genus bearing marks of close relation.

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* In some of its characters it approaches the aquatic *Oligochæta limicolæ.* Eisen's Californian genus, Ocnerodrilus, is like it in the separation of the two vasa deferentia of each side until the external aperture is reached. Criodrilus approaches it in having an incompletely double dorsal vessel.

Thus far a single species has been seen. It is rather common in Illinois, generally occurring in soil, although occasionally found associated with species of Allolobophora in the compost heaps of gardeners. It is apparently not at home in the latter situation, and the large examples are almost always taken in damp soil, where they probably breed. It is sometimes common in lawns, and after protracted rains may be secured in considerable numbers along walks, where it has been belated during its nocturnal wanderings. Its burrows extend for some depth into the soil, and, like Lumbricus, it excavates, during droughts, a chamber at the bottom of its burrow, where it remains coiled up and perhaps inactive. Beyond this, little is known of its habits.

With regard to its distribution outside the State nothing positive can be said at present, but the writer is disposed to believe that he has seen this or a similar worm in the Eastern States. Within the State it is generally distributed, and will probably be found to occur in other states in the Mississippi Valley.

Notes on the Histology.

In the course of attempts to stain examples of Diplocardia for section cutting, a surprising difference between it and the genus Allolobophora becomes apparent. Allolobophora stains well in Grenacher's borax carmine preparation, the nuclei of all the tissues being brought out with the stain in a very satisfactory way. Diplocardia, on the contrary, does not stain well in this fluid, the result generally obtained with it being a diffuse color, with the nuclei of muscle and connective tissue poorly differentiated. The results were not due to any difference in the method of killing or preservation, for specimens of the two genera killed and preserved at the same time and in the same way gave this difference, and proved it to be due to something in the tissues themselves. Just what this something is we are not prepared to state, but the manner in which the tissues respond to the stain would seem to indicate a difference in the chemical or physical properties of the tissues of the two genera, — a difference hardly compatible, the writer thinks, with any very close relation of the worms.

The muscle fibers in the longitudinal layer of the body-wall are irregularly disposed (Figs. 13, 16, 17), and cross sections show nothing of the double series so characteristic of this layer in Lumbricus. With this exception there seems to be no essential difference between Diplocardia and Lumbricus with respect to the muscular system. The layers of the body-wall have about the same thickness relative to each other in both genera. Measurement of the body-wall beneath the nerve cord in the anterior part of the body of a Diplocardia of medium size gave a diameter of .40 mm., of which the cuticle and hypodermis together equaled .05 mm., the circular muscle layer .09 mm., and the longitudinal muscle layer .26 mm. In the greater part of the wall of the alimentary canal the muscular tissue is not very conspicuous. In the gizzard, of course, it is greatly in excess of other tissues. (See Fig. 10.) In the rectum, also, the muscular layers become prominent. Measurements of the anterior portion of the rectum gave a thickness of .05 mm. each for the epithelium and circular muscle layer, and about .02 mm. for the longitudinal layer. Near the vent there is a still further increase in all the tissues, measurement giving for the epithelium a diameter of .15 mm., for the circular muscle layer .10 mm., and for the longitudinal layer .05 mm. Everywhere the muscle fibers are bound together by connective tissue, which, in the body-wall, forms, in places, layers of some thickness; but probably nothing comparable to the "bundles" of vertebrate muscle exists.

Cross sections of muscles present a good deal of variation in the size and shape of fibers. Some of this is due to the state of contraction in which the fibers are fixed by reagents; but there is still variation in size not to be accounted for in this way, and probably indicating a real difference in the size of fibers. Sections may be .008–.012 mm. in longer diameter by .004 mm. in shorter diameter. The ribbon-shaped fibrils of which the fibers are largely made up, are ranged in series extending with the longer diameter of the fiber, giving to sections the appearance of cross striation. In the small fibers they seem to form a single continuous series, the individual fibril being wider or narrower according to the part of the fiber it occupies. But in large fibers the fibrils reach across the shorter diameter only at the ends of the series, and medially form two series, one at each edge, with a central space between them, as if fibrils of a single series had been broken at the middle and the two series thus formed were slightly parted. Upon tearing apart the elements of stained fibers an interstitial granular protoplasm becomes apparent, adhering to the surfaces of fibrils in shreds and deeply-stained knots.

Longitudinal vertical sections of the brain show the latter to be slightly depressed at the sides, where the sections are elliptical in contour. Medially the brain is less flattened. The fibrillar central tissue is surrounded everywhere, except anteriorly and along the ventral middle line, by numerous rather small unipolar nerve cells of the usual structure. Certain of the anterior cells, above and below, are larger than the others and occupy a depression in the fibrillar substance. The nervous tissue is invested and protected by fibrous connective tissue, the nuclei of which are scattered among the nerve cells and occur between the divisions of the fibrillar nervous matter. Outside this investing material is a moderately thick sheath, in which may be distinguished numerous blood vessels, connective tissue, and a highly refracting granular material, the nature of which has not been determined. Upon the posterior surfaces, dorsal and ventral, the bands of muscle referred to in another part of this paper can be seen, the larger bands consisting of about three fibers. Excepting these bands there seems to be no muscular tissue in the brain sheath. The sheath covering the dorsal side of the brain has a very sharply-defined inner boundary consisting of a membrane, apparently of homogeneous matter and probably a modified connective tissue. There is some appearance of such a membrane at the ventral side, but it is here much less distinct. The outer limits of the sheath are not well defined. The commissures between the cerebral and sub-œsophageal ganglia are enclosed in a thin sheath, in which may be seen the same refracting granules as are found in the brain sheath. No muscular tissue is present, apparently.

The sheath of the ventral nerve chain has a well-defined outer and inner limiting membrane of modified connective tissue, similar to that described for the cerebral ganglion. From the inner one, in some sections, fibers may be seen passing in among the other tissues of the sheath, while occasional strands of connective tissue extend from it across the cord, at the sides of the median giant fiber, to the membrane of the opposite side of the cord. The sheath is not as thick on the first ventral mass as it becomes farther to the rear, and it lacks here the muscle fibers, most of its substance being made up of granular matter and of blood capillaries. The muscular tissue of the sheath appears between the first and second ganglia, and shows on ganglion 2 as a series of fibers next the inner enclosing membrane of the sheath, the sheath being still made up largely of the refracting granular material. Beneath the slender anterior division of the intestine the muscular tissue of the nerve cord becomes better developed, the fibers being large and not so closely confined to the inner membrane of the sheath. In the region of somites 19 and 20 the sheath is largely made up of muscle. (Fig. 19, Pl. IV.) The fibers of this muscle have exactly the same structure as those in the body-wall, consisting of series of flattened fibrils, with central space and interstitial protoplasmic substance. The sheath becomes thinner again posteriorly and loses much of its muscular character, the fibers appearing, as in front, as a series along the inner membrane of the sheath. (Fig. 21, Pl. IV.)

It seems evident that the function of these muscles of the nerve sheath is to adjust the cord to the very great changes in the length of the body of the worm, and to accommodate it to the abrupt bending of the body from side to side which occurs during the creeping and burrowing operations of the living worm. A sudden change in length from a foot to six inches requires that the nerve cord be, by some means, readily adjusted to so abrupt and pronounced a change without taking harm or having its office interfered with. The longitudinal muscle fibers of the sheath doubtless shorten the cord at such times and prevent its being thrown into folds. Sections of the cord from greatly shortened worms show an expanded condition, probably attributable to this action of the muscles. These sections may be circular in outline, while sections from worms killed in an extended condition are transversely elliptical.

Within the sheath of the ventral cord, connective tissue, giant fibers, nerve cells, and fibrillar nervous tissue are arranged as they are in Lumbricus and Allolobophora. The nerve cells occupy the lateral and ventral space within the sheath, and lie in little hollows in the connective tissue, with their contracted ends converging towards the points at which their fibers pass into the central nervous tissue. Most of the fibers from cells reach this tissue at the middle of the outside of the mass, and in sections are seen in a cluster about this region. Another set sends fibers into the inner ventral side of each half of the fibrillar tissue. (Pl. IV., Fig. 21.) The cells are thickly placed along the swellings, but become less abundant as the commissures are neared, and in the intervals between ganglia are completely lacking for a short distance.

The central substance of the nerve chain is seen, in cross sections, as two lightly staining areas, chiefly granular or fibrillar, apparently according to the reagents through which the tissue has been passed. At the center of the swellings this matter fuses across the middle line below the giant fibers. Elsewhere the substance of each side remains separate, with the intervening space occupied by fibrous connective tissue.

The giant fibers are three in number, as in Lumbricus and Allolobophora, and occupy the same position relative to the other parts of the cord as in these genera. They do not appear in the subœsophageal ganglion, but in the interval between this and the succeeding mass the median fiber appears abruptly, while the two smaller lateral fibers appear some distance further to the rear. In the region of the eighth or ninth somite the lateral fibers become clearly visible, but are not yet half the diameter of the median fiber. At the extreme posterior end of the cord the giant fibers are lacking, but beneath the rectum the three are of equal size, the lateral fibers having gradually increased in diameter from before backward. The connective tissue completely invests the fibers which lie in the ganglia in a series just within the sheath of the cord and chiefly above the central nervous substance. They do not vary with the cord in diameter, and to accomodate them to the diminished size of the cord between ganglia the median fiber is there brought down between the divisions of the central nervous matter. Unlike these structures in Allolobophora, the giant fibers are in this worm provided with a thick and well-defined connective tissue sheath (Plate IV., Fig. 19, *a*) which isolates them from the surrounding connective tissue. The axis of each fiber is hollow, and in the living worm is filled with a semifluid matter which, in the sections of hardened tissue, is seen as a deeply staining granular residue, sometimes forming a film on the wall of the cavity, sometimes giving imperfect stellate transections, and, again, filling the whole space. The walls of the axial space are well-defined, and in many cross sections examined I have seen a ring of small discs about it, as if the wall were made up of small longitudinally disposed rods, the discs being their cross sections. Focusing on sections with high powers gives an appearance of fibers passing from this wall into the central space.* The fibers of the connective tissue sheath of the giant fibers seem to anastomose with those of the ordinary connective tissue of the nerve cord. The fibers of the sheath seem to join the "rods" immediately about the axial space. Nothing has been seen of the vertical septum mentioned by Dr. Leydig as dividing the cavity of the median fiber in Lumbricus, and no connection between the giant fibers and the nerve cells or central nervous tissue has been found.

As to the function of the giant fibers I am disposed to accept Vejdovsky's view, that they are supporting structures instead of parts of the nervous apparatus proper. Whether or not they can be considered homologues of the notochord of vertebrates must, it seems to me, be left until more has been done with the embryology of invertebrates. They probably originate with the sheath and connective tissue of the cord, and thus independently of the essential nervous tissues.†

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* See Dr. Leydig's note on the giant fibers of earthworms. (*Die riesigen Nervenröhren im Bauchmark der Ringelwürmer*, *Zool. Anz.*, 1886, p. 591.)

† Structures which resemble the giant fibers of earthworms are present in the ventral cord of Cambarus, and are said to occur also in

The columnar epithelial cells with which the alimentary canal is lined are, in a large part of the canal, indurated and united at their inner ends, and in the middle division of the intestine are densely and strongly ciliated.

Nothing of interest can be added to the published accounts of the hypodermis in related worms. Numerous gland cells of several forms occur with the more slender cells which make up the bulk of the layer. Toward the anterior and posterior extremities of the body the cells become gradually longer, and thus approach in character the epithelium of the stomodæum and proctodæum.

Sense organs in the form of small clusters of fusiform cells, bearing a close resemblance to the goblet-shaped organs of the skin of fishes and amphibians, are very abundant in the hypodermis about the ambulatory setæ.

Within the wall of the alimentary canal are developed extensive blood sinuses, the great extent of which was not suspected before the wall was studied by sections. In the large division of the intestine there is a considerable space between the intestinal epithelium and the circular muscle layer, which is filled with blood. Across this space stretch bands of connective tissue from the epithelium to the muscle layer. (Pl. III., Fig. 14.) In the small anterior division of the intestine, also, we find an extensive system of lacunæ in which the blood circulates, and is brought in contact with the lining epithelium of the canal. (Pl. III., Fig. 15.) It is in these spaces, doubtless, that the blood receives the food material secreted from the contents of the intestine.

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other arthropods. As seen in the above-named genus they lack the connective tissue sheath so conspicuously developed in Diplocardia, and owing to the more perfectly disparate character of the cord there is no place for a median fiber. They appear to be simply longitudinal channels in the connective tissue, and represent, perhaps, the axial part of the fibers of earthworms. These channels contain, in preserved tissues, a residue in which, in addition to the minute granules such as occur in the fibers of Allolobophora, there are scattered corpuscular bodies of larger size.

The appended account of North American earthworms has been drawn up largely from the works of Eisen, Rosa, and Uhde. Only the *oligochæta terricolæ* are given, and probably the list of these will prove far from complete when more attention has been given to collecting and studying our species. The *Lumbricus americanus*, Perrier (*Recherches pour servir l'histoire des Lumbriciens Terrestres*, p. 44), which is said by its describer to represent in New York the *L. terrestris* of Europe, is probably one of the species of Allolobophora of the list given below. The description of *L. apii*, Kinberg, from California, has not been seen.

I wish here to acknowledge indebtedness to Prof. Forbes for his kindness and liberality in the matter of special papers on Oligochæta, and to Messrs. McCluer and Weed, who have remembered me on several occasions with fine lots of living specimens.

FAMILY LUMBRICIDÆ.

GENUS TETRAGONURUS, EISEN.

(Öfv. af K. Vet.-Akad. Förh., 1874, No. 2, p. 47.)

Prostomium only partly dividing the buccal somite. Outlets of vasa deferentia in somite 12. Intervals between the four double rows of setæ about equal. Body cylindrical anteriorly ; quadrate in section posteriorly.

Tetragonurus pupa, Eisen.

T. pupa, Eisen, Öfv. af K. Vet.-Akad. Förh., 1874, No. 2, p. 47.

Somites 40. Clitellum on somites 18–22. Tubercula pubertatis on somites 19, 20, and 21. Length, 25 mm. Niagara, Canada (Eisen).

GENUS ALLOLOBOPHORA, EISEN.

(Öfv. af K. Vet.-Akad. Förh., 1873, No. 8, p. 46.)

Prostomium not completely dividing the buccal somite. Outlets of vasa deferentia in somite 15. Setæ in pairs or separated.

Allolobophora bœckii, Eisen.

Lumbricus puter, Eisen, Öfv. af K. Vet.-Akad. Förh., 1870, p. 959.
Dendrobæna bœckii, Eisen, ib., 1873, No. 8, p. 53.
Allolobophora bœckii, Rosa, Lumbricidi del Piemonte, 1884, p. 48.

Setæ in four nearly equidistant rows, the dorsal interval a little the largest. Somites 80–95. Clitellum on somites 29–33. Tubercula pubertatis on somites 31, 32, and 33. Length of living examples, 30–40 mm. Newfoundland (Eisen).

Allolobophora riparia, Hoffm.

Lumbricus riparius, Hoffm., Arch. f. Naturg, 1843, p. 189.
Allolobophora chlorotica, Rosa, Lumbricida del Piemonte, 1884, p. 34.

Dorsal pores beginning between somites 3 and 4. Setæ of pairs close together. Somites 80–100. Tubercula pubertatis on somites 31, 33, and 35. Clitellum on somites 29–37. Length 50–80 mm. California (Eisen.)

Allolobophora fœtida, Savigny.

Enterion fœtidum, Sav., Cuv., Hist., des progr. des sc. nat., 1828, T. 4, p. 14.
Lumbricus olidus, Hoffm., De verm. quib. ad gen. Lumb., 1842.
Allolobophora fœtida, Eisen, Öfv. af. K. Vet.-Akad. Förh., 1873, No. 8, p. 50.

Dorsal pores beginning before somite 7. Setæ of pairs close together. Somites 85–105. Tubercula pubertatis on somites 28, 29, 30, and 31. Clitellum on somites 25,* 27–32. Length 80 mm. Champaign, Ill., abundant.

Allolobophora subrubicunda, Eisen.

A subrubicunda, Eisen, Öfv. af. K. Vet.-Akad. Förh., 1873, No. 8, p. 51.

Dorsal pores beginning before somite 7. Intervals between setæ 1, 2, 3, and 4, about equal. Somites about 110. Tubercula pubertatis on somites 28, 29, and 30. Clitellum on somites 26–31. Length 90 mm. Niagara, Canada (Eisen).

Allolobophora mucosa, Eisen.

A. mucosa, Eisen, Öfv. af K. Vet.-Akad. Förh., 1873, No. 8, p. 47.
Lumbricus communis, Hoffm. (in part), Arten d. Regenw., 1845.

Dorsal pores beginning before somite 7. Setæ of pairs close together. Somites 130. Tubercula pubertatis on somites 29, 30, and 31. Clitellum on somites 25, 26–32. Length 50–70 mm. when alive and moderately extended. Champaign, Ill., frequent. New England (Eisen).

Allolobophora turgida, Eisen.

A turgida, Eisen, Öfv. af K. Vet.-Akad. Förh., 1873, No. 8, p. 47.
Lumbricus communis, Hoffm. (in part).

Dorsal pores beginning between somites 8 and 9. Setæ of pairs close together. Somites 104–240. Tubercula pubertatis on somites 31 and 33. Clitellum on somites 27, 28–34, sometimes 27, 28–35. Length 60–160 mm. Champaign, Ill., abundant; also received from North Carolina. New England and Canada (Eisen).

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*The numbers indicating the position of the clitellum are here used as in the descriptions of Eisen, the first number showing the degree to which the anterior portion of the clitellum may vary.

Allolobophora tenuis, Eisen.

A. tenuis, Eisen, Öfv. af K. Vet.-Akad, Förh, 1874, No. 2, p. 44.

Somites about 100. Clitellum on somites 25, 26–31. Tubercula pubertatis on somites 28 and 29. Length 50–60 mm. N. England, Canada, California (Eisen).

Allolobophora tumida, Eisen.

A. tumida, Eisen, Öfv. af K. Vet.-Akad. Förh., 1874, No. 2, p. 45.

Somites about 40. Clitellum on somites 21–28. Tubercula pubertatis on somites 26 and 27. Length about 30 mm. N. England (Eisen).

Allolobophora parva, Eisen.

A. parva, Eisen, Öfv. af K. Vet.-Akad. Förh., 1874, No. 2, p. 46.

Somites about 100. Clitellum on somites 23–29. Tubercula pubertatis on somites 24, 25, 26, 27, 28, and 29. Length about 40 mm. N. England (Eisen.)

Allolobophora nordenskioldii, Eisen.

A. nordenskioldii, Eisen, On the Oligochæta collected during the Swedish Arctic Expeditions in the years 1870, 1875, and 1876, p. 6.

Somites 80–125. Tubercula pubertatis on somites 28, 29, and 30. Length 80–150 mm. Closely allied to *A. fœtida*. Obtained by Eisen in Siberia; credited to North America by Vejdovsky.

GENUS LUMBRICUS, LINNÉ.

(Linné, Syst. Nat., 1735.)

Prostomium completely dividing the buccal somite. Outlets of vasa deferentia in somite 15. Setæ in pairs, four to each somite.

Lumbricus herculeus. Savigny.

Enterion herculeum, Sav.. Cuv., Hist. des progr. des sc. nat., II.. p. 108, 1828.
Lumbricus terrestris, Linné, 1767.
Lumbricus agricola, Hoffm., 1842.

Somites 112–180. Clitellum on somites 32–37. Tubercula pubertatis on somites 33, 34, 35, 36. Length of living examples 150–300 mm., varying in alcohol, according to Rosa, from 90–150 mm. New England (Eisen).

Lumbricus rubellus, Hoffm.

Somites 95–150; bi- or triannulate. Clitellum on somites 26, 27–31, 32. Tubercula pubertatis on somites 28, 29, 30, 31. Length 70–120 mm. Newfoundland (Eisen).

Lumbricus purpureus, Eisen.

L. purpureus, Eisen, Öfv. af K. Vet.-Akad. Förh., 1870, No. 10, p. 956.

Somites 90, bi- or triannulate. Clitellum on somites 28–33. Tubercula pubertatis on somites 29, 30, 31, 32. Length of living worms 50–70 mm., of alcoholics 30–50 mm. Niagara, Canada (Eisen).

FAMILY ACANTHODRILIDÆ.

This family is represented by the genus Diplocardia, which has been described in the first division of this paper. Hundreds were seen this spring in this locality, migrating during showers of rain.

FAMILY PLUTELLIDÆ.

This family is represented by *Plutellus heteroporus*, described by Perrier, in 1873, from Pennsylvania. The following characters will serve to distinguish it from other worms: Setæ, eight in each somite, equidistant. Spermathecæ, a pair in each of somites 5, 6, 7, 8, and 9, each with a blind appendage. Entire nephridium in one somite, not extending through the anterior septum. External outlets of oviducts in somite 10, in line with inner setæ. External outlets of vasa deferentia in somite 18. Clitellum in somites 14, 15, 16 and 17. A "prostate gland" and penis present. Length 150 mm.

FAMILY PERICHÆTIDÆ.

A fine species of the genus Perichæta is becoming common in the hot-houses of the University, where it has probably been introduced with exotic plants. The numerous described species of this genus have been obtained chiefly from southeastern Asia, and, as far as I know, this is the first record of its occurrence in North America. I have not seen all the published descriptions, and can not, therefore, determine it as to species.

The worm is noticeable among our forms from its active movements and extreme irritability. Body cylindrical, smooth, shining. Color, olive-brown, lighter below. Somites 110. Clitellum on somites 14, 15, and 16, constricted. External outlet of oviducts single, median, in a slight prominence on the ventral side of somite 14. Male outlets in two large ventro-lateral papillæ, one on each side of somite 18. Four pairs of spermathecæ a pair, opening at the anterior edge and ventral side of somites 6, 7, 8, and 9 respectively. Rings of setæ with a very slight median ventral hiatus, 48–55 in a ring, as counted in the anterior part of the body. Length 138–150 mm.

EXPLANATION OF THE FIGURES.

PLATE I.

FIG. 1.—Longitudinal vertical section through the anterior part of the body. *a*, Pharynx. *b*, Gizzard, showing the two thick bands of transversely disposed muscle of which its walls are largely composed. *c*, Œsophagus. *d*, Cerebral ganglion. *e*, Ventral nerve chain. *f*, Two of the thickened muscular septa.

FIG. 2.—Anterior part of the alimentary canal. *a*, Pharynx, with radiating bands of muscle. *b*, Gizzard. *c*, Œsophagus. *d*, Swollen beginning of intestine. *e*, "Prostate glands."

FIG. 3.—Anterior part of the dorsal vessel and part of the genital organs. *a*, Dorsal vessel. *b*, Two of the large "aortæ". *c*, One of the small contorted afferent blood vessels. *d*, Spermathecæ. *e*, Seminal vesicle (?). *f*, Testicle. *g*, Ovary. *h*, Oviduct.

PLATE II.

FIGS. 4-9.—Cross sections of the pharynx, showing the manner in which the dorsally situated tongue extends into the cavity of the pharynx. *a*, Pharynx. *b*, Nerve cord which supplies integument in region of prostomium. *c*, Tongue, appearing as a slight dorsal fold in Fig. 6. and becoming gradually larger and more muscular posteriorly, as in Fig. 9. *d*, Cerebral ganglion. *e*, Subpharyngeal ganglion.

FIG. 10.—Cross section of the muscular gizzard.

FIG. 11.—Dorsal view of the prostomium and the six anterior somites.

FIG. 12.—Ventral view of somites 13-20, showing the clitellum on somites 13-18. *a*, External aperture of the oviducts. *b*, One of the anterior copulatory papillæ. *c*, Copulatory setæ and aperture of "prostate gland". *d*, External aperture of vasa deferentia. *e*, One of the posterior copulatory papillæ.

PLATE III.

FIG. 13.—Cross section through the intestine. *a*, Dorsal vessel. *b*, Intestine. *c*, Typhlosole. *d*, Subintestinal blood vessel. *e*, Ventral nerve chain. *f*, Sections of small contorted afferent blood vessel. *g*, Cuticle of integument. *h*, Hypodermis. *i*, Circular muscle layer. *j*, Longitudinal muscle layer.

FIG. 14.—Part of the wall of the intestine greatly enlarged. *a*, Ciliated intestinal epithelium. *b*, Coagulated blood occupying sinuses between epithelium and circular muscle layer (*c*) of intestine. *d*, Longitudinal muscles of intestine. *e*, Bands of tissue extending across sinuses from epithelium to circular muscle layer. *f*, Connective tissue layer.

Fig. 15.— Cross section through œsophagus. *a*, Dorsal vessel. *b*, Œsophagus. *c*, Blood spaces in walls of œsophagus. *d*, Chloragogue layer.

Fig. 16.— Cross section of the body in the region of the rectum. *a*, Dorsal vessel. *b*, Rectum. *d*, Subintestinal blood vessel. *e*, ventral nerve cord.

PLATE IV.

Fig. 17.—Section of the body-wall passing through the ducts of the anterior "prostate glands." *a*, Sections of the embedded vasa deferentia. *b*, Ducts of the "prostate glands" passing to the exterior. *c*, Portions of the copulatory setæ. *d*, Ventral nerve cord. *e*, Longitudinal muscle layer of body-wall. *f*, Circular muscle layer of body-wall. *g*, Hypodermis.

Fig. 18.— *a*, Locomotor seta. *b*, Copulatory seta.

Fig. 19.— Cross section of the ventral nerve cord of anterior part of body, from between ganglia. *a*, Sheath of large median giant fiber. *b*, One of lateral giant fibers. *c*, Greatly developed muscular sheath of cord. *d*, Fibrillar nervous tissue invested with connective tissue. *e*, Axial substance of median giant fiber here drawn to one side.

Fig. 20.— Dorsal view of cerebral ganglion. *a*, Nerve which supplies region of prostomium. *b*, Commissure. *c*, Muscular bands arising from posterior side of ganglion.

Fig. 21.— Cross section of ventral nerve cord from posterior part of body through ganglion. *a*, Median giant fiber. *b*, Lateral giant fiber. *c*, Sheath of cord. *d*, Fibrillar nervous tissue. *e*, Unipolar nerve cells. *f*, Origin of lateral nerve.

Fig. 22.— Enlarged section of typhlosole and dorsal vessel, showing small intestinal vessel entering dorsal vessel at *b*. *a*, Left division of dorsal vessel. *c*, Dorsal vessel of right side, without intestinal branch (due to section not being true). *d*, Typhlosole.

PLATE V.

Fig. 23.— Ovary.

Fig. 24.— Oviduct.

Fig. 25.— Section of an ovum from the ovary. *a*, Investing connective tissue membrane (probably lost or resorbed when the egg is set free). *b*, Nuclei of connective tissue membrane. *c*, Nucleus of ovum. *d*, Nucleolus.

Fig. 26.— Spermatheca. *a*, Cœcum. *b*, Duct.

Fig. 27.— Copulatory fossa greatly enlarged. *a*, Fossa. *b*, Vasa deferentia, which unite near the external aperture at *c*. *d*, Aperture of "prostate glands". *e*, Copulatory setæ.

Fig. 28.— "Prostate gland". *a*, Duct.

PLATE I.

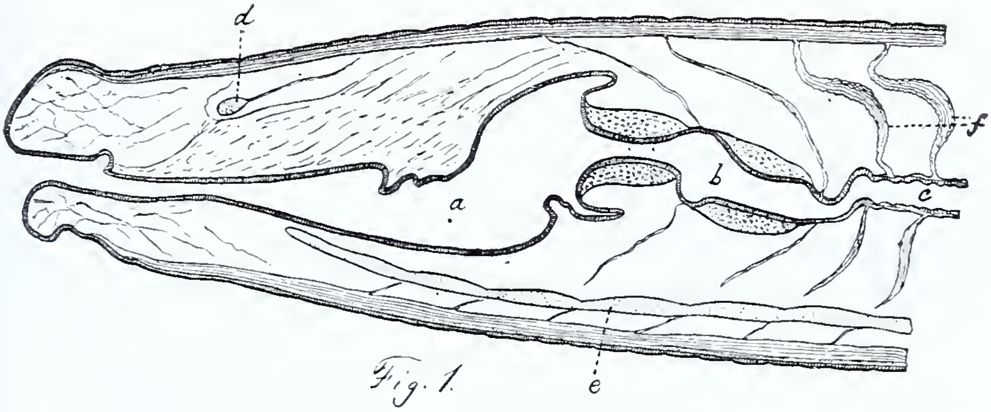


Fig. 1.

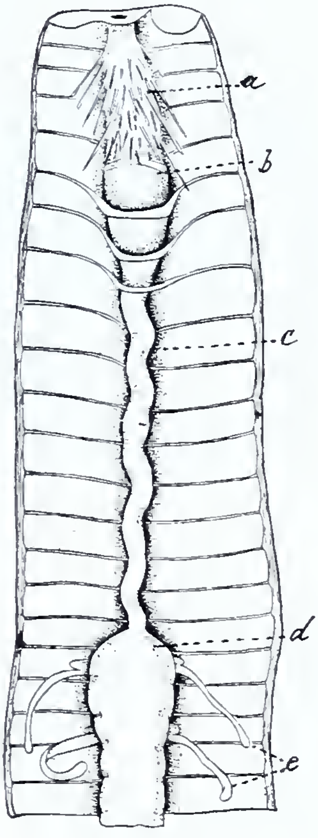


Fig. 2.

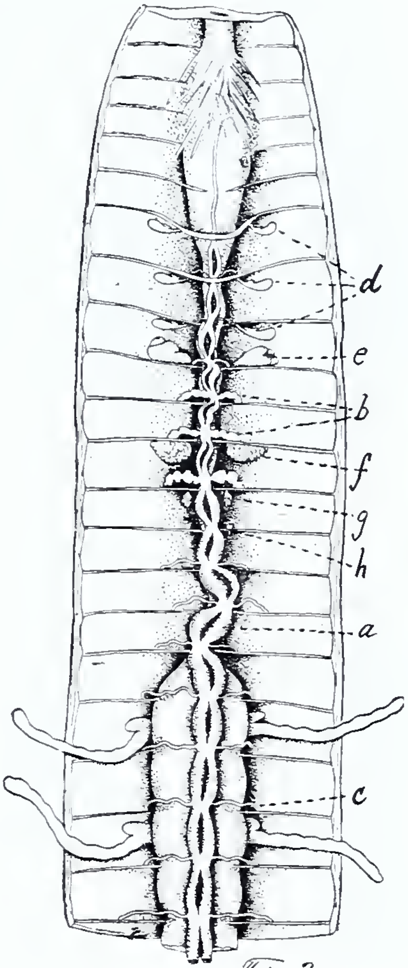
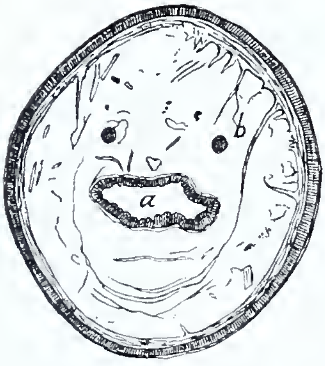


Fig. 3.



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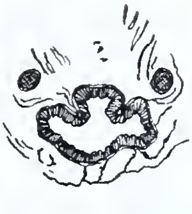

Fig. 5.

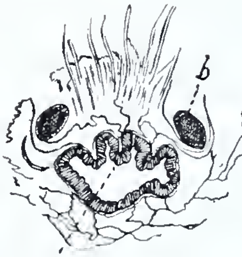

Fig. 6.

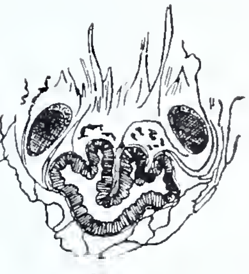

Fig. 7.

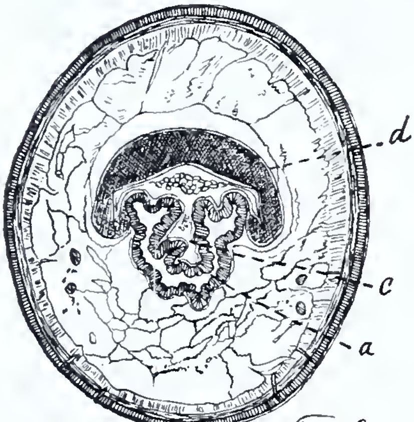

Fig. 8

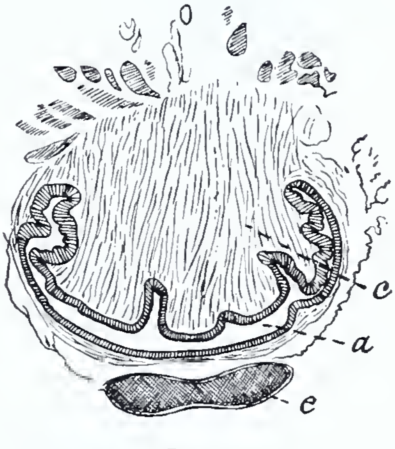

Fig. 9.

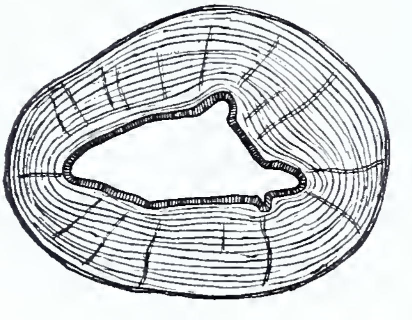

Fig. 10.

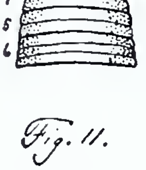

Fig. 11.

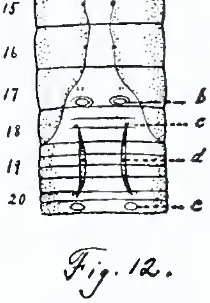

Fig. 12.

PLATE II.

PLATE III.

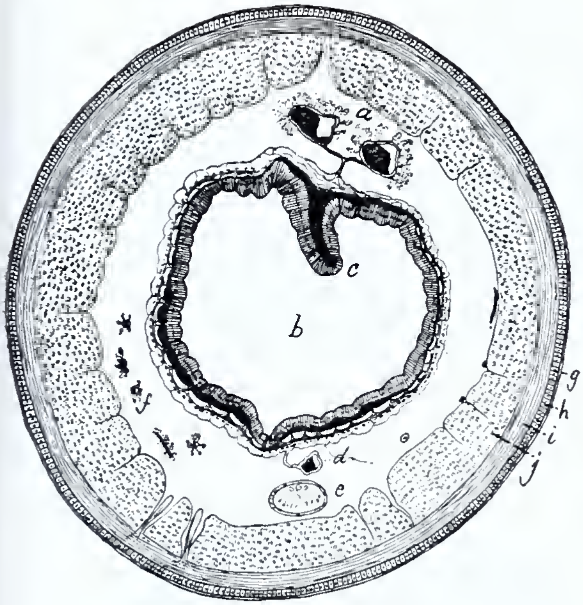

Fig. 13.

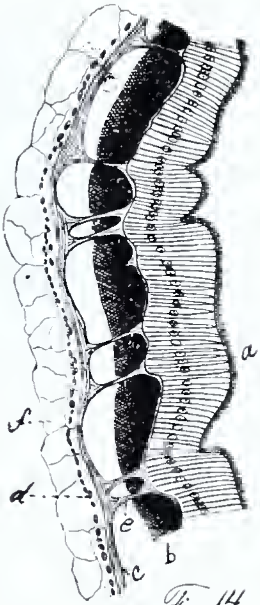

Fig. 14

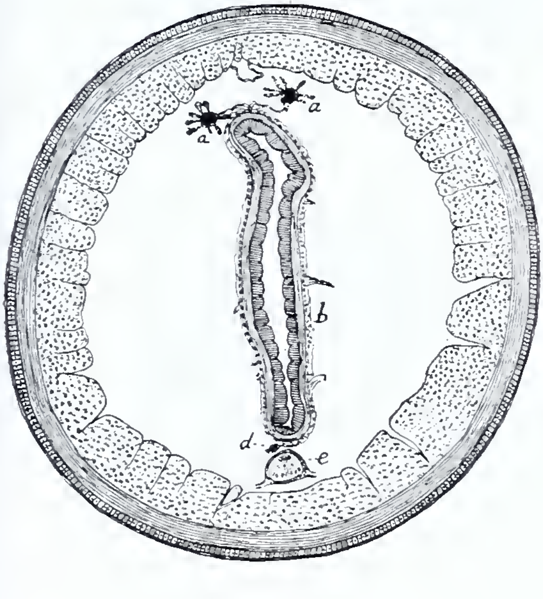

Fig. 16.

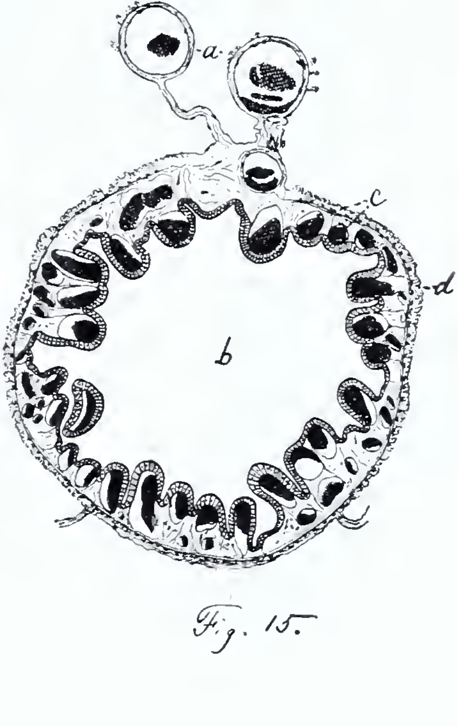

Fig. 15.

PLATE IV.

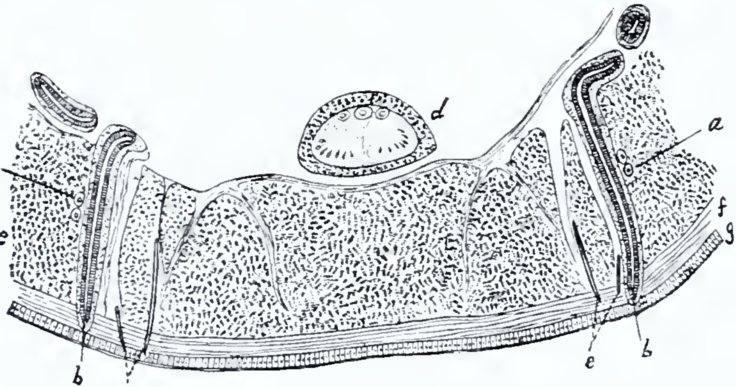

Fig. 17.

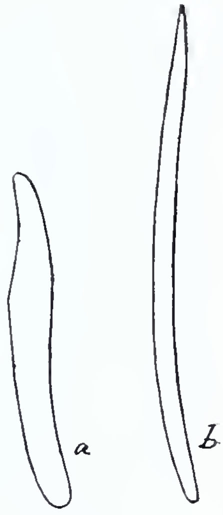

Fig. 18.

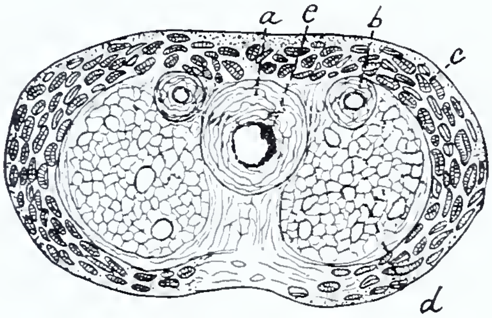

Fig. 19.

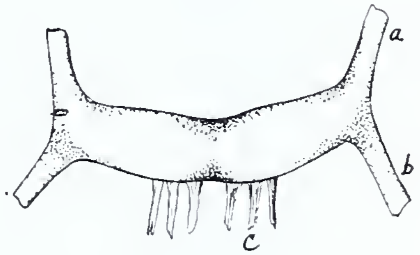

Fig. 20.

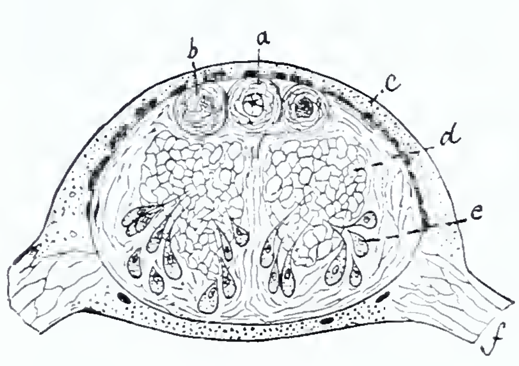

Fig. 21.

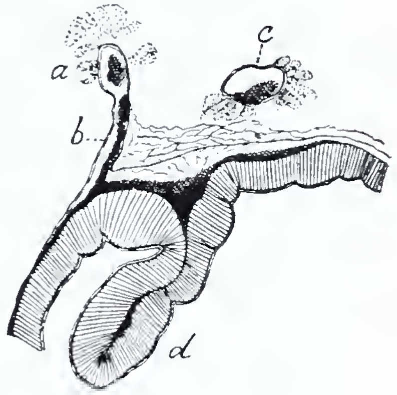

Fig. 22.

PLATE V.

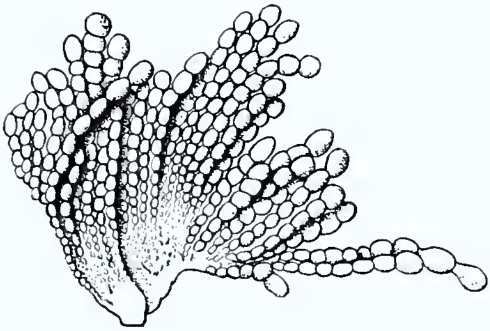

Fig. 23.

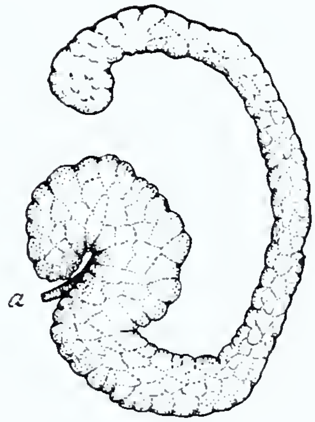

Fig. 28.

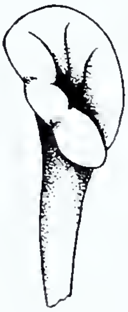

Fig. 24.

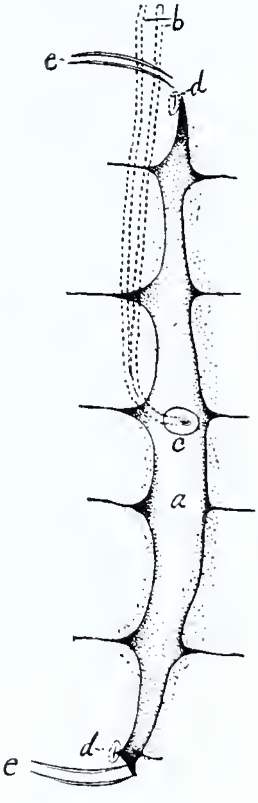

Fig. 27.

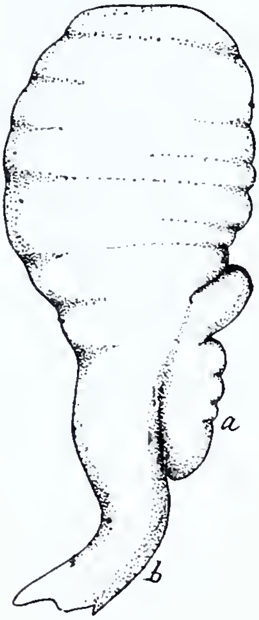

Fig. 26.

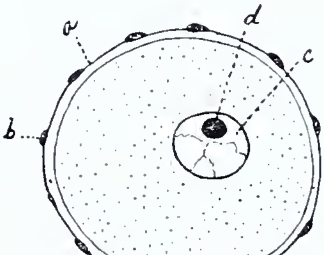

Fig. 25.

ARTICLE V. — *A Descriptive Catalogue of the Phalangiinæ of Illinois.* By CLARENCE M. WEED, M. SC.

INTRODUCTION.

The great majority of the American species of those familiar creatures commonly known as "harvest-men" or "daddy-long-legs" (not to be confounded with the crane-flies — *Tipulidæ* — which go by by the latter name in Europe) belong to the subfamily *Phalangiinæ* of the family *Phalangidæ* of the suborder *Opilonea* and order *Arthrogastra*. Though abundant and widely distributed, these arachnids have as yet received comparatively little attention in this country. The first American descriptions were published by Thomas Say in 1821 (Jour. Phil. Acad. Nat. Sci., Vol. II., pp. 65–68), when four species were characterized under the genus *Phalangium*. Besides the above the only descriptive paper that has appeared is that by Dr. Horatio C. Wood, Jr., entitled "On the Phalangeæ of the United States of America," which was published in 1868 in the Communications of the Essex Institute (Vol. VI., pp. 10–40). In 1885, Prof. L. M. Underwood published a list of the described species (Canadian Entomologist, Vol. XVI., pp. 167–169), but added nothing to our knowledge of the group. Finally, in the "American Naturalist" for October, 1887 (Vol. XXI., p. 935), the present writer published a brief note calling attention to the proper generic position of several species hitherto retained in the old genus *Phalangium*.

In the present paper I have followed, in a general way, the classification adopted by Simon in his admirable monograph Les Arachnides de France (Vol. VII.), and my characterizations of genera are little more than translations from this author. For an elaborate discussion of the anatomy and relations of the group, I must refer the reader to the above monograph and other general works on the subject.

The Laboratory collections on which this paper is based, have largely been made within the last two years, and represent the phalangid fauna of the northern, central, and southern portions of Illinois. I have also received, through the kindness of my brother, Mr. Howard E. Weed, a fine series of certain species from Lansing, Michigan; and from Mr. T. P. Carter, a number of specimens collected at Jacksonville, Ill. I am, further, under special obligations to Mr. Chas. W. Woodworth, who has verified my determinations of several of Wood's species by comparison with the types in the Museum of Comparative Zoölogy at Cambridge; and have to thank Professors Forbes and Garman and Mr. Chas. A. Hart for many favors.

The Phalangiinæ are found abundantly from midsummer until late in autumn in the fields and woods, especially about rocky ledges, and in the vicinity of barns and out-houses. They ordinarily hide during the day, but at twilight wander about in search of food. Until quite recently it has generally been supposed that they captured and ate living insects; but Dr. H. Henking, of Germany, has shown* that they prefer dead insects, and seldom, if ever, attack living ones. The females of most species deposit spherical white eggs in the ground in autumn, and the adults ordinarily do not survive the winter. One species *(Liobunum (?) formosum)*, however, seems to be an exception to this rule, as I have found the adults abundant during the early spring months.

The harvest-men are easily collected and preserved in alcohol for study or exhibition. As the genital organs are frequently of great value in determining species, it is well to preserve them exposed — a simple operation, requiring only that the abdomen of the living specimen be compressed between the thumb and finger, when these organs will be extruded, and if the specimen is immediately dropped into alcohol will ordinarily remain exposed.

CHAMPAIGN, ILL., NOV. 22, 1887.

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* Zeitschrift für Wissenschaftliche Zoologie, Vol. XLV., p. 87.

SUBFAMILY PHALANGIINÆ.

Arachnids having the body composed of a single piece with long slender legs. Teguments not coriaceous. Segments only indicated by striæ, which are often obsolete. Five ventral segments. A single anal piece. Two lateral pores easily seen. Stigmata visible. Maxillary lobe of palpus with two tubercles. Epistoma in the form of a triangular plate.

The three genera that have been recognized in Illinois may be distinguished as follows :

I. First joint of mandibles with a tooth on ventral surface near base.
  A. Maxillary lobes of second pair of feet, with a large base, impressed, straight and elongated, not attenuate, but rather a little enlarged from the base to the apex and very obtuse ; claw of palpus denticulate .... *Liobunum.*
  B. Maxillary lobes of second pair of feet forming elongated triangles, quite large at the base, then gradually retracted, not impressed, with anterior border straight ; claw of palpus not denticulate .... *Oligolophus.*
II. First joint of mandibles without tooth ...... *Phalangium.*

LIOBUNUM, C. KOCH, 1839.

Teguments soft or subcoriaceous. Striæ of the cephalothorax and of the three last abdominal segments very distinct ; those of the anterior segments scarcely or not at all distinct (especially in the ♂). Anterior and lateral borders of the cephalothorax smooth. Eye eminence relatively small; smooth or, rarely, provided with small, slightly distinct, tubercles; widely separated from the cephalic border. Lateral pores small, oval, and marginal. Anal piece large, transverse-oval or semicircular, much wider than long, and much wider than the reflected borders of the eighth segment. Mandibles short, similar in the two sexes ; first joint furnished at the base below with an acute tooth. Palpi simple ; femur, patella, and tibia without any process and without projecting angles ; maxillary lobe provided at the base with two strong, conical teeth. Maxillary lobe of the second pair of feet very long, nearly straight from the base, not attenuated, directed mesad nearly horizontally, and united on the ventro-meson to the lobe from the opposite side without forming a sensible angle; the two together lightly arched on the cephalic border, and forming an even curve. Sternal piece large, slightly contracted between the fourth pair of coxæ, gradually enlarging and obtusely truncate cephalad. Feet very long and slender ; tibia of the second pair with a few false articulations. Palpal claw denticulate.

The following synopsis will aid in distinguishing our Illinois species:

1. *L. dorsatum.* Dorsum grayish or reddish brown, with distinct central dark marking. Palpi long, reddish brown. Body of ♂ 5 mm. long; second legs 50 mm. Northward.

2. *L. vittatum.* Much like *dorsatum*, but body is larger and legs are much longer. Body of ♂ 7 mm. long; second legs 90 mm.

3. *L. nigropalpi.* Dorsum reddish brown, with central marking subobsolete. Middle joints of palpi blackish. Body small; legs very long. Body of ♂ 4 mm. long; second legs 100 mm.

4. *L. verrucosum.* Dorsum reddish, with subobsolete central marking. Palpi brownish white. Body large, with legs comparatively short and thick. Body of ♂ 6.5 mm. long; second legs 50 mm.

5. *L. elegans.* Dorsum blackish on margins, brownish in middle, with a faint indication of a central marking. Palpi light brown. Very small, with long, slender legs. Body of ♂ 3.2 mm. long; second legs 38 mm.

6. *L. politus.* Dorsum and trochanters clear reddish brown, with scarcely an indication of a central marking. Body of ♂ 5 mm. long; second legs 51 mm.

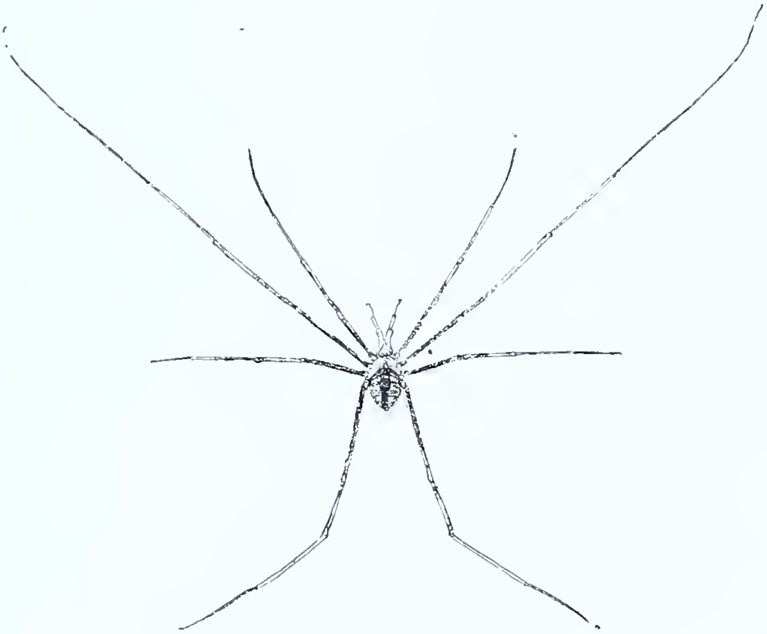
7. *L. (?) calcar.* Dorsum reddish brown, with faint central marking. Femur of palpus, with a robust spur-like process on its outer ventro-lateral surface. Body of ♂ 7.5 mm. long; second legs 40 mm.

8. *L.* (?) *formosum.* Dorsum very smooth, blackish. Patella of palpus with its inner distal lateral angle prolonged into a short apophysis, with a thin brush of hairs on its lateral surface. Body 5 mm. long; second legs 22 mm.

L. dorsatum, (Say).

Phalangium dorsatum, Say, Jour. Phil. Acad. Nat. Sci., Vol. II., p. 66.
———— ———— Wood, Commun. Es ex Inst., Vol. VI., p. 18.

♂. Body 5 mm. long, 3.5 mm. wide. Palpi 7 mm. long. Legs: I., 27 mm.; II., 50 mm.; III., 27 mm.; IV., 36 mm.



Liobunum dorsatum. ♂

Dorsum granulate, varying from a light grayish-brown to a deep reddish-brown, often of an intermediate, somewhat golden, tint. A well marked dark stripe begins at the eye eminence, expands for a short distance, then contracts until it reaches the cephalic portion of the abdomen, whence it runs with parallel sides a short distance, then very slightly expands until it reaches the caudal third of the abdomen, where it contracts and runs as a stripe to the anus. Cephalothorax with an irregular parallelogrammic dark V-shaped marking cephalad of the eye eminence, sometimes obsolete, especially in older specimens. In some individuals there is so much black cephalad of the eye eminence that the central marking appears to begin on the cephalic margin of the cephalothorax. Eye eminence of about equal height, length, and breadth, sloping slightly backward, dark above, canaliculate, with a few (two to five or six) subobsolete acute blackish tubercles. Mandibles very light brown, tips of claws black; dorsal surface of second joint sparsely covered with short spinous hairs. Palpi long, reddish brown, depth of color varying with the rest of the body. Femur with a row of short conical tubercles on its outer ventro-lateral surface, commencing near the base and running to the apical extremity, where there are about a dozen similar tubercles on the ventral surface; another short, slightly oblique series on the dorsal surface, beginning at the apical margin and extending distally about one fourth the length of the femur. Patella with a row of tubercles on its outer ventro-lateral surface, similar to those on the femur, and a few subobsolete ones on its dorsal and ventral surfaces. Tibia with two nearly parallel rows of tubercles, one on the ventral and the other on the outer ventro-lateral surface; a short row also on the distal portion of its inner ventro-lateral surface. Tarsus sparsely covered with stiff hairs, and furnished with a well pronounced row of dark tubercles on its inner ventro-lateral surface. Ventrum varies from whitish to dark reddish-brown, with well marked granulations in older specimens. Coxæ slightly tuberculate, each having a row of short tubercles on the cephalic margin. Legs varying from light grayish-brown to black, with darker annulations. Shaft of penis slender, distally bent nearly at right angles, and terminating in a very acute point.

♀. Body 5–7 mm. long, 3.5–4.5 mm. wide. Palpi 5 mm. long.

Legs: I., 27–30 mm.; II., 50–61 mm.; III., 28–31 mm.; IV., 40–44 mm.

Differs from male as follows:

Body much thicker and more rounded. Color generally darker with much less reddish. Legs brownish rather than black. Palpi very much more slender, shorter, and having the tubercles partially replaced by hairs. Apical portion of ovipositor white, with no dark rings.

Described from many specimens. Collected by the hundred in Champaign county at all times between the latter part of June and early in November. Also taken at various dates late in summer and throughout the fall in Edwards, Kankakee, Lake, La Salle, McLean, and Morgan counties, in Illinois, and received from Lansing, Michigan.

This is by far the commonest species throughout the northern portion of the State. It develops largely in the fields and woods, and, when full grown, apparently migrates to the vicinity of houses, barns, and out-buildings, where it sometimes congregates in great numbers. I have found the young ones very common in corn fields, among the leaves of the growing plants, where I suspect they live upon the numerous small insects drowned in the moisture contained in the bases of the unfolding leaves. They become mature in June.

I was at first much puzzled over this species because of the great variation in the color of different specimens, and was inclined to separate the series then at hand into two species. Being able to find, however, no structural difference, and noticing that the deeply colored specimens were the only ones obtained late in autumn, and, also, that the light ones were only taken early in the season (*i. e.*, soon after they became adults), it occurred to me that the color might vary with the age of the individual. After examining hundreds of specimens collected at various times between July and November, I became convinced that such was the case, and the field observations of the present season have verified the conclusion.

L. vittatum, (Say).

Phalangium vittatum, Say, Jour. Phil. Acad. Nat. Sci., Vol. II., p. 65.

——————— Wood, Commun. Essex Inst., Vol. VI., p. 20.

♂. Body 7 mm. long, 4 mm. wide. Palpi 7 mm. long. Legs: I., 44 mm; II., 89 mm.; III., 45 mm.; IV., 64 mm.

Dorsum reddish brown, with a central dark marking commencing at the eye eminence and extending caudad to the ultimate or penultimate segment, slightly contracting near cephalic margin of abdomen, then gradually expanding until about the beginning of the caudal third of the abdomen, where it again slightly contracts. Ventrum slightly paler than dorsum; both finely granulate and entirely glabrous. Eye eminence slightly wider than high, black above, canaliculate, with small black tubercles over the eyes. Mandibles light yellowish-brown, tips of claws black; second joint with short, sparse hairs. Palpi long, reddish brown; tarsal joints paler. Femur and patella curved, with two rows of rather blunt, dark tubercles on the outer ventro-lateral surface; femur also having a few small subobsolete ones on its dorsal surface. Tibia with a similar row on its outer ventro-lateral surface, a short row on the distal portion of its inner ventro-lateral surface, and a short row on the proximal portion of its ventral surface. Tarsus pubescent, with a row of short, blunt, black tubercles on the inner ventro-lateral surface, extending from the base to near the apex. Legs light brown or black, patella generally black and tarsi brown, the other joints varying from one color to the other. Coxæ reddish brown, minutely tuberculate. Trochanters generally dark brown, with minute scattered tubercles. Femora and patellæ with fine spinose tubercles. Tibiæ with very short hairs. Shaft of penis slender, subcylindrical, not broadened distally, bent at an obtuse angle and terminating in a very acute point.

♀. Body 8–9 mm. long, 5–6 mm. wide. Palpi 5 mm. long. Legs: I., 42 mm.; II., 90 mm.; III., 43 mm.; IV., 61 mm.

Besides its rounder body and much more robust appearance, it differs from the male as follows:

Dorsum of a much darker shade of brown, with less of the reddish tint, and ventrum paler. Second joint of mandibles with fewer hairs. Palpi shorter, more slender, with the rows of tubercles on the tibia subobsolete, and that on the tarsus entirely wanting. Legs generally light brown, with black annulations at the articulations. Ovipositor white, with no color in the apical rings.

Described from many specimens collected in Union Co., Ill., September 25th, 1886. It has also been obtained in Johnson Co., Ill., and at East Cairo, Ky.

This species is very abundant on the rocky ledges of certain parts of southern Illinois, being, in fact, the commonest harvest-man in the region, apparently replacing *P. dorsatum.* On the farm of Mr. Parker Earle, at Cobden, I obtained a long series of both sexes, the creatures being everywhere abundant about the rocky bluffs running across the place.

Dr. Wood has shown that *L. vittatum* and *L. dorsatum* are very closely allied and difficult to separate. According to him, the former may be looked upon as the southern representative of the latter, of which he had never seen any specimens from farther south than Washington, D. C. After examining hundreds of specimens of *dorsatum* and dozens of *vittatum*, I am unable to find any constant structural character by which they may be separated, though the difference in the size of the body and length of legs is very marked. I have only collected the latter species late in the season when the individuals were fully colored, but from some alcoholics collected earlier, I judge that it undergoes the same color changes as *dorsatum.*

L. nigropalpi, (Wood).

Phalangium nigropalpi, Wood, l. c., p. 22.

♂. Body 4 mm. long, 3 mm. wide. Palpi 4 mm. long. Legs: I., 49 mm.; II., 99 mm.; III., 50 mm.; IV., 67 mm.

Dorsum minutely tuberculate, reddish brown, with a subobsolete dark central marking, sometimes simply represented by obscure dark blotches. Eye eminence at least as broad as high, black above, canaliculate, with small black tubercles on the carinæ. Mandibles light yellowish-brown, tips of claws black; second joint with sparse hairs. Palpi slender, light brown, distal portion of femur, and almost all of patella, black; femur, patella, and tibia with small scattered tubercles, and short hairs; tarsus pubescent, with a row of subobsolete, small, black tubercles on its inner ventro-lateral surface. Ventrum paler than dorsum, of a nearly uniform tint. Coxæ minutely tuberculate, of same color as ventrum. Trochanters black. Legs very long, slender, black, with white annulations at distal extremities of femur and tibia, especially in the second and fourth pairs. Shaft of penis flattened, contracted near its distal extremity, and bent upwards, terminating in an acute point.

Described from many specimens collected at Cobden, Union Co., Ill., 25th September, 1886. We have also specimens from Johnson county.

The males of this species are much more numerous than the females. Out of a large number of specimens collected, I was surprised not to find a single female. Wood states that he found six times as many males as females. According to him, "The females are to be distinguished by their larger size, the brown color of their legs and palpi, as well as the darker and less uniform color of the dorsum, which also frequently loses almost all of the reddish tint."

This species is chiefly remarkable for the enormous length of its legs. Though the body is very small, the legs are immensely developed. Like *L. vittatum*, this harvest-man frequents the rocky ledges of southern Illinois, where it is quite abundant. I have never taken it anywhere else.

L. verrucosum, (Wood).

Phalangium verrucosum, Wood, l. c., p. 29.

♂. Body 6.5 mm. long, 4 mm. wide. Palpi 4.5 mm. Legs: I., 27 mm.; II., 50 mm.; III., 28 mm.; IV., 39 mm.

Dorsum minutely tuberculate (almost appearing finely granulate), of a rich dark golden-brown color, somewhat darker in front, with a faint indication of a dark central marking in some specimens. Eye eminence well pronounced, longer than high, black above, scarcely at all canaliculate, with two rows of small black tubercles, frequently subobsolete. Mandibles light brown, tips of claws black; second article with sparse dark hairs. Palpi slender, grayish or brownish in some specimens, with more or less black on basal joints. Femur with short, scattered hairs; ventral surface beset with well-developed black tubercles. Patella curved, with short hairs and small black tubercles. Tibia and tarsus thickly beset with short hairs; without tubercles, except a subobsolete row on the inner ventro-lateral surface of tarsus. Ventrum grayish brown, cephalic portion tuberculate. Legs dark brown or black. Trochanters tuberculate. Femora, patellæ, and tibiæ, with rows of small spines. Shaft of penis straight, except at tip, broad, flat; about two thirds of the way from the base to the apex expanding into an alate portion, which continues for about one fifth the entire length of the shaft, then suddenly contracting into a rather robust, curved, canaliculate end, and terminating in an acute point; with two curved spinous hairs just behind the base of the jointed tip.

Described from several specimens collected in Champaign Co., Ill., 23d to 26th June, and 8th July, 1887.

L. **elegans**, sp. n.

♂. Body 3.2 mm. long, 2.1 mm. wide. Palpi 2.1 mm. long. Legs: I., 19 mm.; II., 38 mm.; III., 20 mm.; IV., 29 mm.

Dorsum blackish at the margins, especially on the abdomen, and light brownish in the middle, with a faint indication of a central marking. Finely granulate, with numerous very small black tubercles scattered in patches over the surface, and a transverse row of larger whitish tubercles on each abdominal segment. Eye eminence prominent; light brown, darker above; canaliculate, with two rows of well developed tubercles, having whitish bases and black tips. Mandibles whitish, tips of claws black. Palpi slender, light brown. Femur, patella, and tibia, with distant, short, spinose tubercles. Tarsus with whitish hairs. Ventrum whitish brown, with a transverse row of tubercles on each abdominal segment, and the pectus and coxæ closely tuberculate. Legs very slender, proximal portions light brown, distally darker. Femora furnished with minute blackish spines.

Described from two specimens collected in Champaign Co., Ill., during the autumn of 1886.

L. **politus**, sp. n.

♂. Body 5 mm., long, 2.8 mm. wide. Palpi 3.5 mm. long. Legs: I., 25 mm.; II., 51 mm.; III., 26 mm.; IV., 36 mm.

Dorsum smooth, finely granulate: clear reddish brown, with no marking and only a faint indication (shown by a slightly dark shade) of the usual central marking. Eye eminence rather prominent, black above, canaliculate, with a regular curved series of small, acute, black spines over each eye. Mandibles whitish, with tips of claws black. Palpi slender, whitish, with femur and patella dusky; finely pubescent, with a subobsolete row of minute dark tubercles on the inner ventro-lateral surface of femur, and another row on the inner ventro-lateral surface of tarsus. Ventrum reddish brown. Coxæ, including the membranous distal lateral tips, reddish. Trochanters brownish red. Proximal portions of legs light brown, darker distally. Shaft of penis nearly straight, slender, flattened, canaliculate, distal portion very slightly expanded, then slightly contracted, and again expanded in a half spoon-shaped portion, and terminating in a small, acute point.

Described from three specimens collected about a shed, Champaign Co., Ill., 25th July and 9th August, 1887.

L. (?) calcar, (Wood).[1]

Phalangium calcar, Wood, l. c., p. 26.

♂. Body 7.5 mm. long, 4.5 mm. wide. Legs: I., 21 mm.; II., 40 mm.; III., 22 mm.; IV., 32 mm.

Dorsum reddish brown, minutely tuberculate, tubercles blackish, some specimens having a faint indication of a central marking, and scattered light-colored spots. Eye eminence of moderate size, of nearly equal height, length, and breadth; black above; scarcely at all canaliculate; with two rows of small acute tubercles. Mandibles brownish white, with obscure markings of a darker color, especially on the inner dorso-lateral surface of the second joint, where they are arranged in the form of a series of irregular parallelograms; dorsal surface of second joint sparsely clothed with stiff hairs; tips of claws black. Palpi long, very robust; reddish brown, lighter distally. Femur enlarging from base to apex, with a very robust spur-like process on its outer ventro-lateral surface near the distal extremity, the anterior edge of which is provided with a row of short, black tubercles; dorsal surface of femur with numerous scattered, short, black tubercles; and a few also on the proximal portion of the inner ventro-lateral surface; sparsely provided with spinous hairs. Patella short, thick, so united with the femur as to form an arch, with sparse hairs and a few scattered tubercles on its dorsal and outer lateral surfaces. Tibia arched, densely clothed with long black hairs; a patch of short black tubercles on the proximal portion of its ventral surface, and a short row of similar tubercles on the apical portion of its inner ventro-lateral surface. Tarsal joint densely clothed with long black hairs, with a thick row of short black tubercles on its inner ventro-lateral surface, terminating in a short denticulate claw. Ventrum light reddish-brown. Coxæ reddish, with a few short hairs; two anterior pairs with a row of subobsolete tubercles on the cephalic border. Trochanters light brown, darker dorsally. Remaining joints of legs light brown with darker annuli; femora, patellæ, and tibiæ, with rows of short spines. Shaft of penis very robust, flattened, distally contracted and curved, and terminating in a short, acute point.

Described from four specimens collected in Champaign Co., Ill., 23d June and 9th August, 1887, and at Cave-in-Rock, Hardin Co., Ill., 27th July, 1883.

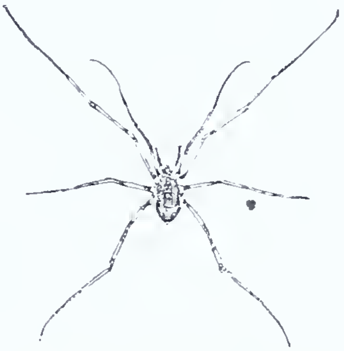
So far as I know, the female of this rare form has never been taken.

I refer this species, provisionally, to *Liobunum*, although, on account of the spur-like process on the femur of the palpus, it does not strictly belong there.

L. (?) formosum, (Wood).

Phalangium formosum, Wood, l. c., p. 30.

♂, ♀. Body 4–6 mm. long, 2.5–3 mm. wide. Palpi 2.6 mm. long. Legs: I., 10 mm.; II., 22 mm.; III., 11 mm.; IV., 16 mm.



LIOBUNUM (?) FORMOSUM

Dorsum remarkably smooth, mottled with gray and blackish brown; wide a dark brown or black central marking commences on the cephalic margin and runs to the middle of the fifth abdominal segment, where it abruptly terminates; it is expanded on the cephalothorax, contracted on the first abdominal segment, and then again expanded. The entire abdomen caudad of the middle of the fifth segment usually much lighter than the part cephalad. There is a peculiar oblique sinus caudad of each lateral pore. Eye eminence brownish, perfectly smooth, not at all canaliculate, almost hemispherical. Mandibles whitish, with the usual black tips to the claws; second article with sparse blackish hairs on dorsal surface. Palpi rather slender, mottled, distally whitish; furnished with short blackish hairs. Patella with its inner distal lateral angle prolonged into a short apophysis, and having a rather thin brush of hairs on its inner lateral surface. Tarsal claw denticulate. Ventrum, including coxæ, grayish brown, cephalic portion with short dark hairs. Trochanters brownish black. Legs light brown, ringed with dark brown; furnished with very minute blackish spines.

Described from many specimens collected in Champaign, Effingham, and McLean counties.

I refer this species to the genus *Liobunum*, for the present, with considerable hesitancy, as it does not strictly belong there on account of the projecting inner angle of the palpal patella. Its life history also is different from that of any other member of the family with which I am acquainted, as it lives over winter as an adult instead of depositing eggs and dying in autumn, as do the other species. I have collected it repeatedly under boards in fields during the months of September, October, November, January, April, and May.

PHALANGIUM, LINN. 1758.

Teguments soft or subcoriaceous. Striæ of the cephalothorax, and of the three last abdominal segments very distinct, those of the five cephalic segments only slightly so. Cephalic border of the cephalothorax smooth: lateral border more or less toothed; dorsum nearly always furnished with small teeth. Dorsum of abdomen having transverse series of small teeth or hairs. Eye eminence of medium size, canaliculate, provided with two series of pointed tubercles, always separated from the cephalic border by a space larger than its diameter. Lateral pores large, elongate-oval, sub-marginal, visible from above. Anal piece quite small, wider than long, of the same width, or scarcely narrower than the curved borders of the eighth segment. Mandibles short and simple in the female, often more developed and provided with tubercles in the male; first article unarmed below. Palpi simple, often having the inner distal angle of the femur and of the patella very slightly produced, but never prolonged into a process; hairs equal, or sometimes thicker on the inner side, but not forming a brush; patella always shorter than tibia; maxillary lobe provided at the base with two conical tubercles. Maxillary lobe of the second pair of legs much longer than wide, gradually narrowing from the base to the extremity, directed obliquely forward and not meeting, anterior border straight. Pectus large, parallel between the coxæ, rounded in front or slightly lanceolate, more rarely enlarged and obtusely truncate. Feet long, more or less robust, tibiæ without false articulations. Claws of palpus simple.

P. cinereum, Wood.

Phalangium cinereum, Wood, Commun. Essex Institute, Vol. VI., p. 25.

♂. Body 5–6 mm. long, 3 mm. wide. Palpi 4 mm. long. Legs: I., 21–32 mm.; II., 42–52 mm.; III., 23–33 mm.; IV., 32–43 mm.

Dorsum cinamon-gray, with a slightly darker subobsolete, wide, vase-shaped, central marking; with transverse series of small spinose tubercles caudad of the eye eminence, and a curved series cephalad of it. These tubercles having whitish bases and acute black apices, and also generally having a spinous hair arising on one side of the tubercle near the apex of the white portion, and reaching beyond the tip of the tubercle. Cephalad of the eye eminence, there are also two longitudinal series of these tubercles of about three each. Lateral borders of cephalothorax sub-sinuate. Eye eminence low, canaliculate, with a series of five or six tubercles, like those on the dorsum, surmounting each eye. Mandibles brownish white, tips of claws black; second joint and apical portion of first joint furnished with short, black, stiff hairs. Palpi light brown, rather slender, first four joints with minute tubercles and short black hairs; none of the angles prolonged; tarsal joint without tubercles, but with hairs. Claw moderately robust. Ventrum (including coxæ), light grayish-brown, with many somewhat quadrangular patches of a more pronounced brown, and scattered blotches of chocolate-brown. Trochanters light brown, with many small tubercles. Remaining joints of legs cinnamon-brown, more or less annulated with darker and lighter shades; angular, with longitudinal rows of black spines. Sheath of penis subcylindrical, truncate. Shaft robust, with two lateral oval openings near distal extremity, then contracted into a blunt scoop-shaped piece, turned upward at nearly a right angle, and terminating with a slender acute point.

In very small specimens of this species, as of many others of the group, the tubercles on the body and members are often partially wanting or replaced by hairs.

♀. Body 7.8 mm. long, 3.5 mm. wide. Palpi 4 mm. long. Legs: I., 20 mm.; II., 36 mm.; III., 20 mm.; IV., 28 mm.

Differs from ♂ as follows:

Dorsum darker gray, more mottled; central marking more distinct. Tubercles on eye eminence more numerous, and those forming the longitudinal series cephalad of the eye eminence also more numerous. Palpi with hairs, but without tubercles. Legs with annulations more distinct; trochanters without tubercles; spines on femur less prominent and on tibia obsolete. Narrow quadrangular brown patches on ventrum of abdomen arranged in transverse series. Distal joints of ovipositor black.

Described from many specimens collected in Champaign Co., Ill., during October, 1886, and August, 1887. I have also received a fine lot of this species from my brother, Mr. Howard E. Weed, collected at Lansing, Michigan, where it was very common during the autumn of 1886.

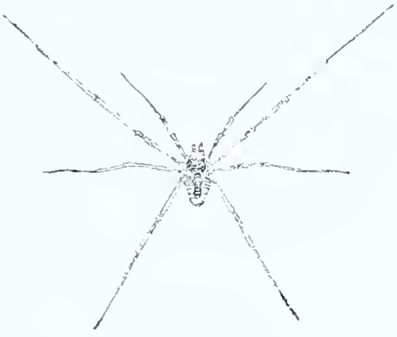
OLIGOLOPHUS, C. KOCH, 1872.

Teguments soft or subcoriaceous. Striæ of the cephalothorax and of the three last abdominal segments very clear, those of the first five segments only slightly distinct. Anterior border of the cephalothorax smooth, or provided at the middle with three small geminated points; lateral borders more or less spiny; dorsal surface of cephalothorax nearly always provided with small teeth. Abdomen presenting transverse series of small teeth or hairs. Eye eminence of medium size, as wide as long, or a little wider than long, lightly canaliculate, provided with two series of low tubercles, separated from the anterior border by a space wider than (often nearly double) its diameter. Lateral pores large, oval, submarginal. Anal piece quite large, wider than long, at least as wide as the bent borders of the eighth segment, rounded before, its posterior border truncate and slightly curved. Mandibles quite short, and normal in both sexes; first article provided below at the base with a pointed tooth, slightly curved in front. Palpi, inner surface of the extremity of the femur, patella, and tibia thickly furnished with hairs forming a brush; upper internal angle of the femur and patella slightly projecting, rarely prolonged; patella slightly shorter than tibia, enlarged from the base to the extremity; maxillary lobe having at the base two conical tubercles. Maxillary lobe of the coxæ, and feet as in *Phalangium.*

O. pictus, (Wood).

Phalangium pictum, Wood, l. c., p. 30.

♂. Body 6 mm. long, 3.2 mm. wide. Palpi 4.1 mm. long. Legs: I., 10 mm.; II., 24 mm.; III., 12 mm.; IV., 17 mm.



Oligolophus pictus. ♂

Dorsum minutely scabrous, mottled ash-gray, much lighter in some specimens than others. Dark central marking generally very distinct, commencing at the cephalic border of the cephalothorax, the dorsal surface of which it almost covers, and suddenly contracting at its caudal margin, so that it starts on the abdomen as a narrow line, slightly wider than the eye eminence, then gradually expanding until it reaches the end of the cephalic third of the abdomen, where it suddenly contracts, its borders irregularly curving toward the dorso-meson, then expanding again,—though not becoming as wide as before,—and finally gradually contracting and running as a stripe to the anus, or, as in some specimens, simply terminating at the cephalic margin of the penultimate segment. Cephalic margin of cephalothorax nearly straight, lateral angles slightly produced, each having a black spine on an elevated base; three large brownish black tooth-like processes just caudad of the middle of the margin, each terminating with a minute spine, the middle process being slightly cephalad of the others. Dorsad of these but cephalad of the eye eminence, there is a curved series of minute spines on whitish elevated bases, and caudad of the eye eminence on the cephalothorax there are two similar nearly transverse series. There is also a similar transverse series on each segment of the abdomen — most easily seen on the black central marking. Eye eminence large, brownish, canaliculate; each carina having four thick, brownish tubercles, each of which terminates in a black spine. Mandibles light brown, tips of claws black; dorsal surface of second joint and of apical portion of first joint furnished with short black hairs; second joint with a blunt tubercle on its inner dorso-lateral surface, just above the base of the finger forming part of the claw, and the apical portion of its outer lateral surface (caudad of the insertion of the thumb) prolonged into a tubercular process. Thumb with a prominent dorsal tubercle near its base. Palpi mottled; the outer ventro-lateral portion of the femur with an irregular row of long, slender, white tubercles, terminating with black spines; inner ventro-lateral surface with a series of long, black, curved, spinous hairs; inner lateral surface with similar shorter hairs more numerous, forming a brush on the slightly produced inner distal angle; dorsal and outer lateral surfaces with short spinous hairs. Patella nearly as long as tibia, its inner distal angle produced and furnished with a brush of black hairs with recurved tips; shorter hairs in distant rows on its dorsal and lateral surfaces. Tibia with its inner lateral distal angle slightly swollen, but not projecting forward as does that of the patella, but furnished with a similar brush of hairs; outer ventro-lateral surface with a subobsolete row of white tubercles, tipped with spinous hairs; dorsal and outer lateral surface furnished with sparse short hairs. Tarsus thickly covered with long black recurved hairs, usually with a row of subobsolete, short, black tubercles on its inner ventro-lateral surface, and terminating in a moderately robust simple claw. Ventrum light grayish-brown, hispid. Legs short, robust. Coxæ light gray, covered with spinous hairs on elevated bases. Trochanters light brown or grayish, tuberculate. Remaining joints mottled with blackish brown and gray; all except tarsi with longitudinal rows of small black spines, and acute tubercles on their dorso-distal borders. Tibiæ angular. Tarsi hairy. Sheath of penis enlarged distally, truncate; shaft moderately robust, distally canaliculate, then expanded into a spoon-shaped portion, and terminating in a short, black, acute, articulated piece.

♀. Body 7 mm. long, 4.5 mm. wide. Palpi 4.3 mm. long. Ringed portion of ovipositor 4 mm. long. Legs: I., 11 mm.; II., 27 mm.: III., 13 mm.; IV., 20 mm.

Besides its larger size and more robust appearance, it differs from the male in having no tubercles on the mandibles; joints of ovipositor grayish.

Described from many specimens collected in Champaign Co., Ill., during September, October, and November, 1886.

ARTICLE VI. — *A Partial Bibliography of the Phalangiinæ of North America.* By CLARENCE M. WEED, M. Sc.

It is believed that there are included below most of the references to this group in our American literature. I have placed an interrogation point after the genus of several species of *Phalangium* of which I have seen no specimens, but which probably do not belong to that genus as now restricted.

GENERAL ARTICLES.

1821. SAY, THOMAS. An account of Arachnides of the United States. Jour. Phil. Acad. Nat. Sci., Vol. II., (*Phalangiinæ*, pp. 65–68). Complete Writings, Vol. II., pp. 13–15.

The first descriptive paper treating of the group. Four species of *Phalangium* described; viz., *dorsatum*, *vittatum*, *nigrum*, and *grandis*.

1868. WOOD, HORATIO C., JR., M. D. On the Phalangeæ of the United States of America. Communications of the Essex Institute, Vol. VI., pp. 10–40.

An elaborate paper on the family as a whole. Anatomy and habits discussed. 15 species of *Phalangiinæ* described under genus *Phalangium*, 11 being new. Fair wood-cuts illustrate most of the species.

1885. UNDERWOOD, LUCIEN M., Ph.D. A Preliminary List of the Arthrogastra of North America (excluding Mexico). Canadian Entomologist, Vol. XVII. (*Phalangiinæ*, pp. 167–169).

An enumeration of the described species with bibliographical references.

1887. WEED, CLARENCE M. The Genera of North American Phalangiinæ. American Naturalist, Vol. XXI., p. 935 (October, 1887).

Attention is called to the proper generic position of several species. Method of extruding the genital organs of *Phalangiinæ* described.

1889. Weed, Clarence M. A Descriptive Catalogue of the Phalangiinæ of Illinois. Bulletin Illinois State Laboratory of Natural History, Vol. III., Article V., pp. 79–97.

Extended descriptions of ten species, two being new. Notes on distribution, life history, and habits.

REFERENCES TO SPECIES.

1. Liobunum dorsatum, (Say).

Phalangium dorsatum. Say, Jour. Phil. Acad. Nat. Sci., Vol. II., p. 66 (1821). Complete Writings, Vol. II., p. 13.

Original descriptions from specimens in the cabinet of the Academy. "Inhabits the United States."

Phalangium dorsatum, Say. Wood, Commun. Essex Institute, Vol. VI., pp. 18–19, 21, 39, figures 1*a*–1*c*. (1868).

Extended descriptions and measurements of both sexes. Collected in N. Y., D. C., and Penn. An out-door species. Supposed young are whitish. Compared with *P. vittatum*, of which it is supposed to be the northern representative.

Phalangium dorsatum, Say. Packard, Guide to the Study of Insects, pp. 656–657, fig. 632 (1869).

Mention of its distribution. Common at Salem, Mass.

Phalangium dorsatum, Say. Gratacap, American Naturalist, Vol. XVI., p. 120.

Experiments on influence of oxygen on harvest-men. Specimens placed in the gas were somewhat excited, and lived twenty-four hours.

Phalangium dorsatum. Kingsley, Standard Natural History, Vol. II., p. 122 (1884).

Mention.

Phalangium dorsatum, Say. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical references.

Liobunum dorsatum, (Say). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Referred from *Phalangium* of previous authors to *Liobunum* of C. Koch, as defined by Simon.

Liobunum dorsatum, (Say). Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 83–85 (1889).

Elaborate description and measurements. Taken in northern and central Illinois and Michigan. Developed largely in fields and woods, and migrates to houses and barns. Commonest species in northern Illinois. Compared with *L. vittatum*, which is considered its southern representative.

2. LIOBUNUM VITTATUM, (Say).

Phalangium vittatum. Say, Jour. Phil. Acad. Nat. Sci., Vol. II., p. 65 (1821). Complete Writings Vol. II., p. 13.

Original description from specimens in the cabinet of the Academy. "Inhabits the Southern States."

Phalangium vittatum, Say. Wood, Commun. Essex Institute, Vol. VI., pp. 20–21, 39, figs. 2*a*–2*d*. (1868).

Extended description and measurements. Taken in Texas and Nebraska. Compared with *P. dorsatum*, which is supposed to be its northern representative.

Phalangium vittatum, Say. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical references.

Liobunum vittatum, (Say). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Referred from *Phalangium* of previous authors to *Liobunum* of C. Koch, as defined by Simon.

Liobunum vittatum, (Say). Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 85–87. (1889).

Elaborate description and measurements. Common in southern Illinois where it frequents rocky ledges. Taken also in Kentucky. Compared with *L. dorsatum*, which it closely resembles, and of which it is supposed to be the southern representative.

3. LIOBUNUM NIGROPALPI, (Wood).

Phalangium nigropalpi. Wood, Commun. Essex Institute, Vol. VI., pp. 22–23, 39, figs. 3*a*–3*c*. (1868).

Original description from specimens taken in woods in Huntingdon Co., Penn. Males six times as numerous as females.

Phalangium nigropalpi, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical references.

Liobunum nigropalpi, (Wood). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Referred from *Phalangium* of previous authors to *Liobunum* of C. Koch.

Liobunum nigropalpi, (Wood). Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 87–88 (1889).

Elaborate description and measurements. Taken in southern Illinois about rocky ledges. Males much more numerous than females. Remarkable for length of legs.

4. LIOBUNUM VERRUCOSUM, (Wood).

Phalangium verrucosum. Wood, Commun. Essex Institute, Vol. VI., pp. 29–30, 40 (1868).

Original description of some males of unknown locality in the Essex Institute Collection.

Phalangium verrucosum, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical reference.

Liobunum verrucosum, (Wood). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Referred from *Phalangium* of previous authors to *Liobunum* of C. Koch.

Liobunum verrucosum, (Wood). Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., p. 88–89 (1889).

Extended description of male from specimens collected in Champaign Co., Ill.

5. LIOBUNUM ELEGANS, Weed.

Liobunum elegans. Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., p. 89 (1889).

Original description from males taken in Champaign Co., Ill.

6. LIOBUNUM POLITUS, Weed.

Liobunum politus. Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 89–90 (1889).

Original description from males collected at Champaign, Ill.

7. LIOBUNUM (?) CALCAR, (Wood).

Phalangium calcar. Wood, Commun. Essex Institute, Vol. VI., pp. 26–27, 39, figs. *6a*–*6b*. (1868).

Original description of male collected in mountains of southwestern Virginia. Two females that are conjectured to belong to same species also described.

Phalangium calcar, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical reference.

Liobunum (?) calcar, (Wood). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Taken from *Phalangium* of previous authors and provisionally referred to *Liobunum*, although the palpal spur renders its generic position doubtful.

Liobunum (?) calcar, (Wood). Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 90–91 (1889).

Extended description of males collected in Champaign Co., Ill. Provisionally retained in *Liobunum*.

8. LIOBUNUM (?) FORMOSUM, (Wood).

Phalangium formosum. Wood, Commun. Essex Institute, Vol. VI., pp. 30, 40 (1868).

Original description of females collected in the District of Columbia.

Phalangium formosum, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168.

Bibliographical reference.

Liobunum (?) formosum, (Wood). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Taken from *Phalangium* of previous authors and provisionally referred to *Liobunum*, although on account of palpal angle it does not strictly belong there.

Liobunum (?) formosum, (Wood). Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 91–92 (1889).

Extended description of both sexes. Unlike other species, it hibernates as an adult. Provisionally retained in *Liobunum*.

9. LIOBUNUM (?) BICOLOR, (Wood).

Phalangium bicolor. Wood, Commun. Essex Institute, Vol. VI., pp. 28, 39, fig. (1868).

Original description from two females taken in Delaware county, Penn.

Phalangium bicolor, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical reference.

Liobunum (?) bicolor, (Wood). Weed, American Naturalist, Vol. XXI., p 935 (October, 1887).

In absence of specimens, it is conjectured that the species may belong to *Liobunum* rather than *Phalangium*.

10. LIOBUNUM (?) VENTRICOSUM, (Wood).

Phalangium ventricosum. Wood, Commun. Essex Institute, Vol. VI., pp. 32–33, 39, fig. 7 (1868).

Original description of female and supposed male. Taken in Penn. and Neb.

Phalangium ventricosum, Wood. Packard, Guide to the Study of Insects, p. 657, fig. 633 (1869).

Mention. Said to be widely distributed in United States.

Phalangium ventricosum, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 169 (1885).

Bibliographical reference.

Liobunum (?) ventricosum, (Wood). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

In absence of specimens, it is conjectured that this species belongs to *Liobunum* rather than *Phalangium.*

11. PHALANGIUM CINEREUM, Wood.

Phalangium cinereum. Wood, Commun. Essex Institute, Vol. VI., pp. 25–26, 39 (1868).

Original description from specimens taken in northern New York.

Phalangium cinereum, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical reference.

Phalangium cinereum, Wood. Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Said to belong to the genus *Phalangium*, as restricted by Simon.

Phalangium cinereum, Wood. Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 93–94. (1889).

Extended descriptions of both sexes. Taken in Champaign Co., Ill., and at Lansing, Mich.

12. PHALANGIUM (?) MACULOSUM, Wood.

Phalangium maculosum. Wood, Commun. Essex Institute, Vol. VI., pp. 31–32, 40, fig. (1868).

Original description of both sexes from specimens collected in Penn. and W. Va.

Phalangium maculosum, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical reference.

13. PHALANGIUM (?) FAVOSUM, Wood.

Phalangium favosum. Wood, Commun. Essex Institute, Vol. VI., pp. 28–29, 40 (1868).

Original description from a single female collected in Nebraska.

Phalangium favosum, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical reference.

14. PHALANGIUM NIGRUM, Say.

Phalangium nigrum. Say, Jour. Phil. Acad. Nat. Sci., Vol. II., pp. 66–67 (1821). Complete Writings, Vol. II., p. 14.

Original description. "Not uncommon in the Carolinas and Georgia."

Phalangium nigrum, Say. Wood, Commun. Essex Institute, Vol. VI., pp. 34–35, 40 (1868).

Form from Texas and Nebraska, supposed to be same as Say's species described. Say's description also quoted.

Phalangium nigrum, Say. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical references.

15. PHALANGIUM (?) GRANDE, Say.

Phalangium grandis. Say, Jour. Phil. Acad. Nat. Sci., Vol. II., pp. 67–68 (1821). Complete Writings, Vol. II., p. 14.

Original description. "Inhabits the Southern States."

Phalangium grande, Say. Wood, Commun. Essex Institute, Vol. VI., pp. 34, 40 (1868).

Simple quotation of Say's description. Had seen no specimens.

Phalangium grande, Say. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical references.

16. PHALANGIUM (?) EXILIPES, Wood.

Phalangium exilipes. Wood, Commun. Essex Institute, Vol. VI., pp. 23–24, 39 (1868).

Original description from three specimens collected in California and Nevada.

Phalangium exilipes, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 168 (1885).

Bibliographical reference.

17. OLIGOLOPHUS PICTUS, (Wood).

Phalangium pictum, Wood, Commun. Essex Institute, Vol. VI., pp. 30–31, 40.

Original description from a single female, taken near Salem, Mass.

Phalangium pictum, Wood. Underwood, Canadian Entomologist, Vol. XVII., p. 169 (1885).

Bibliographical reference.

Oligolophus pictus, (Wood). Weed, American Naturalist, Vol. XXI., p. 935 (October, 1887).

Referred from *Phalangium* of previous authors to *Oligolophus.*

Oligolophus pictus, (Wood). Weed, Bull. Ill. St. Lab. Nat. Hist., Vol. III., pp. 95–97 (1889).

Extended descriptions of both sexes, collected in Champaign Co., Ill.

ARTICLE VII.—*On an American Earthworm of the Family Phreoryctidæ.* By S. A. FORBES.

In 1843 W. Hoffmeister described in Germany (Wiegmann's Archiv f. Naturgesch., 1843) a peculiar, long, and very slender worm found in a well, giving it the generic name of *Haplotaxis*, and, after its discoverer, Menke, the specific name of *menkeanus*. Two years later this generic name was set aside by the same author for that of Phreoryctes, Haplotaxis having been already used in botany. In 1859 another species of the genus was found, also in Germany, by Schlotthauber and noticed as *Georyctes lichtensteinii* (Beitr. z. Helminthologie),—a name which has now given way to that of *Phreoryctes filiformis* (Claparède) Vejdovský. In 1888 the well-known helminthologist, Beddard, of England, published in the "Annals and Magazine of Natural History" a description of a worm from New Zealand which he assigned with some doubt to this genus under the name of *Phreoryctes smithii*, amending at the same time the definition of the genus (especially with reference to the sexual organs) to include this species. These three forms, two from continental Europe and a doubtful one from New Zealand, are thus the only examples of the genus and family hitherto reported.

In America these worms have been mentioned, previous to the discovery of the present species, only by Minot in the Standard Natural History (1885), where a general illustrated account of the genus is given with the remark that so far as the author knows, it has been found only in Germany.

In March, 1880, the writer hereof received from a well in McLean county, Illinois, and preserved in alcohol, without study, a very long and slender pale red worm, remarkable for its disposition to coil itself into seemingly inextricable knots. In April of the present year (1890) I received from Mr. G. W. McCluer, Assistant Horticulturist of the Agricultural Experiment Station at Champaign, a thick mass of fine roots of the elm, taken from a tile in a farm drain. Here, in company with a large number of the ordinary blind crustaceans of the subterranean waters of this region (*Asellus stygius* and *Crangonyx mucronatus*), I found three living examples of the same worm as that received from the well ten years before, and these proved upon examination to belong unquestionably to the genus Phreoryctes, but to a species undescribed.

From the other Oligochæta the family Phreoryctidæ and its sole genus, Phreoryctes, are distinguished by the long and slender form, the great number of segments, the thick cuticle and weak longitudinal muscular layer; by the simple setæ, placed singly in four longitudinal rows, two ventral and two dorsal (the latter sometimes aborted); and by the convoluted nephridia imbedded in fat cells and opening to the surface before or behind the setæ. The ventral ganglia present two swellings or enlargements in each somite. The sexual glands are said to occur in segments nine to twelve, and the *receptacula seminis* in segments six to eight.

Phreoryctes emissarius, Forbes.*

This worm is allied to *P. menkeanus* by its great length, its pale red color and iridescent luster, and its subterranean habit, by the presence of ventral organs beneath the nerve cord, and by the three pairs of nerves from each ventral ganglion. It differs especially by the fact that the dorsal rows of setæ are obsolete except on a variable number of the anterior segments† and that the lateral vascular arches extend from the dorsal to the ventral vessel, instead of connecting only with the latter. The worm is at least seven or eight inches in length by about .6 to .7 mm. in thickness, and my longest specimen (an imperfect one) contains three hundred and seventy-five segments.

The head or prostomium is not transversely lobed, either without or within, and thin vertical transverse sections give no hint of a cephalic pore. The setæ (Pl.VI., Figs. 1 & 2) begin with very small dorsal and ventral pairs in the first post-oral

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* Amer. Nat. May, 1890, v. xxiv., p. 477.

† None of my specimens are entire, and I am not able to give the characters of the posterior segments.

segment. The ventral setæ continue throughout the body, at first increasing in size backwards, and becoming very large and long and strongly recurved at tip. At the middle of the worm the imbedded part of the seta may extend into the cœlom two thirds the diameter of the body. The tips are obtuse and smooth, and a circular ridge surrounds the seta below the middle. The inserted portion is straight to the tip, from which very numerous distinct slender muscles radiate in all directions to the worms wall. The dorsal setæ diminish in size and disappear between the seventieth and eightieth segments, their occurrence becoming irregular towards the last. In the middle part of the body there is no trace of them nor of the glands for their development.

The large dorsal and subintestinal blood vessels are readily seen in the living worm, as well as the contorted vascular loops extending along the side of the intestine. The dorsal vessel is contractile, and valved at the posterior portion of each cœlomic space by four or five large, pale, nucleated cells, so shaped and attached as to yield to forward pressure but to close against backward. (Pl.VI., Fig. 3). This vessel divides just behind the cerebral ganglion, each branch passing outward and downward under the anterior end of the lateral commissure, and then forward under the lateral part of the cephalic ganglion, and upward and inward to the middle line in front of this ganglion, where the two branches from the opposite sides nearly touch. Each then turns directly backward upon itself and retraces the course just described, the direct and the recurrent portions of the artery running parallel, a short distance apart, until beneath the anterior end of the commissure again, where the vessel turns outward to the body wall.

The lateral branches of the dorsal vessel (Pl.VI., Fig. 4) are given off immediately in front of the posterior dissepiment of each somite, and just behind the valves of the dorsal vessel. Throughout the greater part of the body they run at first upward and outward to the body wall, then irregularly forward (forming as they go a broad, downward loop on the side of the intestine) to the front of the cœlomic space, where they turn directly downward across the intestine, and backward along its lower surface, again forming a broad, downward loop in the ventral portion of the cœlom, in front of the ventral setæ. They terminate finally in the ventral vessel, on the same vertical plane as that of their origin. The anterior arches are less contorted,— the first, indeed, pursuing a nearly direct course from above downward. This vessel is no larger than the others, and is doubtless non-contractile. It is given off at the posterior end of the first segment (subœsophageal), and on the same vertical plane the ventral vessel takes its origin,— probably formed by the union of these arches. This vessel is supported by a vertical mesentery except in the anterior segments, where it is borne at the middle of a delicate transverse membranous partition, which disappears with the formation of the first dissepiment. It is also valved, but imperfectly, at a considerable distance behind the dissepiment.

The cerebral ganglion is transverse, slightly convex in front, and slightly three-lobed, the large anterior nerves going off from the anterior lateral angles by bulbous processes. Ganglion cells are most abundant on the anterior and dorsal surfaces, the inferior posterior surface being nearly free of them. Three pairs of nerves arise from the cephalic ganglion, the first and second large and the third small. The first go outward and downward from their origin to the cephalic wall; the second, arising just behind the first, pass directly downward; and the third, springing from the lateral part of the dorsal surface just before the origin of the commissure, pass directly upward. The commissures send each five nerves to the wall of the head, the four anterior arising in pairs, and the posterior and largest, given off just before the commissures meet in the subœsophageal ganglion, going singly outward. No branches to the pharynx were detected.

The subœsophageal ganglion is transversely oval in front, nearly cylindrical behind, very richly cellular on the lower surface, especially at the middle, and also posteriorly on the sides. The four anterior ventral ganglia are closely approximated and, including the subœsophageal, have but a single pair of branches each.

The ventral cord (Pl. VI., Fig. 5, & Pl. VII., Figs. 6 & 7) generally presents two elongate ganglionic swellings to each somite, corresponding to the two sets of lateral nerves arising.

Ganglion cells are but few on the upper half of the cord, but are almost continuously distributed on the under surface except at the dissepiments, where the cord is rapidly reduced in size and contains no ganglion cells. There is nothing in the nerve cord or its delicate sheath to represent the giant fibers of the earthworm.

The ventral cord is supported beneath, at the center of each somite, between the ganglionic swellings, by the "ventral organs" of Timm (Pl. VI., Fig. 5, & Pl. VII., Figs. 6 & 7),*—pyramidal pads or cushions of cells, the outer ones large, distinct, nucleated, the inner resembling the ganglion cells of the nerve cord itself. The apex of the pyramid extends between the longitudinal muscle bands, and the base of it commonly supports the cord, the lateral angles frequently extending upwards, beside the cord, and sometimes, especially in the anterior somites, half surrounding it (Pl. VII., Fig. 6). In the posterior part of the body, however, the cord and the ventral organs are much less closely connected, and often lie side by side quite free from one another. These cellular masses are longest from before backwards, and are connected with each other by a single nerve fiber running from one to the other, this having occasionally a nucleated cell in its course.

The lateral nerves (Pl. VI., Fig. 5) all pass from their origin outwards and downwards through the longitudinal muscular layer of the body wall to the circular muscle, beneath which they are distributed. They are swollen and slightly ganglionated just beyond their origin. Three pairs of these lateral nerves rise in each somite (excepting a few of the most anterior), two from the posterior swelling of the ganglion and one from the anterior. The posterior pair arise immediately in front of the dissepiment, the second pair a short distance further forward,—commonly immediately behind the ventral organ,—and the first pair (which pass directly downward) at about the anterior fourth of the somite. These nerves are given off on the same horizontal plane, and the pairs are opposite.

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* The structure of these bodies, as well as their greater size in the anterior segments, seems to me to bear out the suggestion of Timm that they are sensory organs.

The nephridia open into the cœlom by a conspicuous broad, shallow, bi-lobed, ciliated funnel (Pl. VII., Figs. 8 & 9) nearly sessile on the anterior face of the dissepiment at about the level of the nerve cord. The larger lobe of the funnel is composed of a single layer of cylindrical cells arranged fan-like, and each covered at its outer end by a dense brush of long and very fine cilia. From this funnel a short tube narrows rapidly backward to the dissepiment, through which it is continued into a narrow lobe of the so-called fatty body of the somite behind (Pl. VII., Fig. 10). These bodies, composed of irregular masses of large cells, contain, according to Leydig,* delicate contorted tubes representing the glandular portion of the nephridia,—a fact difficult to demonstrate positively in prepared slides. They extend upwards beside the alimentary canal, in immediate proximity to the chlorogon layer, their upper end sometimes reaching the dorsal vessel. Below, a slender lobe extending downwards and inwards is supported by one of the setal muscles, which is inserted on the middle line of the ventral body wall. Another lobe extending downwards and outwards, contains the large excretory duct, which passes from the dorsal surface of the intestine with an S-like curve to the body wall (Pl. VI., Fig. 2), where it is rapidly narrowed to a minute tube, which, passing through the body wall, opens, with a slightly expanded orifice, upon the surface about a tenth of a millimeter in front of the seta and quite outside the setal sheath. This orifice, in the living worm, is frequently marked by little accumulations of excrete matter, and the tube can be traced a short distance inward by the thick cuticular lining of its terminal part. The first nephridium appears in the ninth segment, and the first ciliated funnel in the eighth. These structures are, however, rudimentary in the first six segments in which they occur, the fatty bodies being reduced to narrow masses of connective-tissue nuclei which extend up in a single band beside the alimentary canal, immediately behind the dissepiment, and the funnel not being bi-lobed and not always ciliated. No duct or external opening is distinguishable in these anterior nephridia.†

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* Archiv f. Mikrosk. Anat. I., p. 283.

† The segments in which these incomplete nephridia occur, are, according to Beddard, those in which the sexual organs are situated in the sexually mature worm.

The change to the distinctive cell of the fatty body and the fully developed bi-lobed, ciliated funnel is gradual, becoming complete in the fifteenth segment, where, however, the fatty bodies are still very small, occupying only the anterior part of the cœlom. In the posterior somites, on the other hand, the nephridia and the fatty bodies are very large, occupying the greater part of the cœlomic space. There was no trace of sexual organs in any of the specimens studied.

Just behind the tip of each seta is a small oval mass of cells resembling a gland (Pl. VI., Fig. 2) and opening to the surface at the very margin of the setal sheath. The first dissepiment occurs between the fourth and fifth segments. The cœlomic fluid is remarkably destitute of leucocytes.

The pharynx is short, thick-walled, with heavy roughened cuticle, thick, circular and rather few and stout radiating muscles. A broad, low median ridge projects fromthe dorsal wall of this cavity. The œsophagus extends through segments one to three. It is thin-walled in the first two somites, with a thin cuticular lining and scarcely any circular muscular fibers, but very numerous slender radiating muscles extending to the body wall. In the third somite its structure is similar, except that it is provided with a very thick circular muscle and that the radiating muscles are first reduced in number and then disappear. The cuticle is also thicker than that of the preceding part. With the fifth somite the intestine suddenly begins, the muscular wall becoming very thin and the epithelial cells very long and highly and irregularly villose in arrangement (Pl. VII., Fig. 11). Here also begin the chlorogon cells in a thin imperfect layer. The villosities become at first more prominent and irregular backwards, but at about the fifteenth to the twentieth segment are gradually reduced in length, the epithelial lining becoming more uniform in thickness. The intestine is slightly constricted at the dissepiments, and there also the epithelial cells are considerably shortened (Pl. VIII., Fig. 12). The exposed ends of the cells are densely ciliated. The intestinal wall contains capacious blood sinuses which connect at intervals with the dorsal vessel (Pl. VIII., Fig. 12). In the posterior part of the alimentary canal the epithelial cells are very much elongated, and the lumen of the canal small.

The chlorogon layer becomes finally thick and extensive, deeply imbedding the alimentary canal and the dorsal vessel, and extending out upon the branches of the latter as far as the body wall.

In the alimentary canal of the specimens examined were numerous slender, fusiform, monocystid Gregarinidæ (Pl.VIII., Fig. 14), average examples being about .34 mm. long by .02 mm. wide, tapering towards both ends, the anterior extremity with an apparent open pore or sucker by means of which it was commonly adherent to an epithelial cell. In one such case the protoplasmic contents of such a cell were drawn out, by the slight withdrawal of the gregarinid, into a short, thick, striated thread. Each has a large, circular, highly granular nucleus, commonly near the center. In some cases these Gregarinidæ were in masses of half a dozen.

In the cœlom are numerous encysted parasites (Pl. VIII., Fig. 15), usually thick-walled, with a central protoplasmic mass (varying from spherical to crescentic), within which is a spherical, conspicuous, highly granular nucleus, often containing a nucleolus also. These bodies are commonly attached to the inner surface of the longitudinal muscle layer, but are occasionally imbedded in the fatty bodies or lie free in the cœlom.

BIBLIOGRAPHY.

HOFFMEISTER, W. Beiträge zur Kenntniss deutcher Landanneliden. — Wiegmann's Archiv für Naturgeschichte, 1843, Bd. I., pp. 183–198.

———Die bis jetz bekannten Arten aus der Familie der Regenwürmer. Braunschweig, 1845.

SCHLOTTHAUBER, DR. Beiträge zur Helminthologie. ("Amtl. Ber. über 31 Versammlung deutscher Naturforscher und Ärtze zu Göttingen, Sept. 1854. Göttingen, 1866, pp. 122–124.") [Vejdovský.]

CLAPARÈDE, E. R. Recherches sur l'Anatomie d'Oligochètes. Mèm. Soc. Phys. et hist. nat. Genéve, Tom. XVI. 2-de part. 1862, Pl. 1–4, pp. 217–291.

LEYDIG, Fr. Ueber Phreoryctes Menkeanus Hoffm. nebst Bemerkungen über den Bau anderer Anneliden. Archiv für Mikroskopische Anatomie, Bd. I. 1865, pp. 249–294, Taf. 16–18.

NOLL, F. C. Ueber einen neuen Ringelwurm des Rheins. Wiegmann's Archiv für Naturgeschichte, Jahrg. 40, 1874, pp. 266–270, Taf. VII.

VEJDOVSKÝ, F. Beiträge zur Oligochaetenfauna Böhmens. Sitzungsber. d. kön. böhm. Gesellschaft der Wissensch. Prag. 1875, pp. 191–201.

CLAUS, CARL. Grundzüge der Zoologie, Vierte Ausgabe. Marburg, 1880.

MICHAELSEN, W. Die Oligochaeten von Süd-Georgien nach der Ausbeute der Deutschen Station von 1882–83. Jahrb. Wiss. Anst. Hamburg, 5 Jahrg, pp. 55–73, Taf. 1, 2. Abstract: Zoologischer Jahresbericht, 1888, p. 51, Verm.

TIMM, RUD. Beobachtungen an Phreoryctes Menkeanus Hoffm. und Nais. Ein Beitrag zur Kenntnis der Fauna Unterfrankens. Arbeiten des zoolog.-zootom. Inst. in Wurzburg, Bd. VI. (1883), Taf. I., II. Review: Zoologischer Jahresbericht, 1883, I Abth., p. 203.

VEJDOVSKÝ, F. System und Morphologie der Oligochaeten. Bearbeitet im Auftrage des Comité's für Naturhistorische Landesdurchforschung Böhmens. Prag. 1884, pp. 48–50. Abstract: Zoologischer Jahresbericht, 1885, I Abth. Nachtr., pp. 47–57.

MINOT, C. S. Vermes. Order I. Oligochæta. Standard Natural History, Vol. I. [1885], p. 223.

GIARD, ALFR. Sur une nouvelle station de Phreoryctes Menkeanus Hoffmeister. Bull. Scientif. France et Belg. (3) 1. Ann. No. 4 [1888], p. 298.

Beddard, F. E. On the Reproductive Organs of Phreoryctes. Ann. Mag. Nat. Hist., Ser. 6, Vol. I., No. 6 [June, 1888], pp. 389–395, 1 Pl. Abstracts: Jour. Roy. Micr. Soc. 1888, p. 579; Zoologischer Jahresbericht, 1888, p. 54, Verm.

——Anatomy and Histology of Phreoryctes. Abstract: Jour. Roy. Micr. Soc. 1889, Part 6, p. 755. (Proc. Roy. Soc. Edinburgh, Vol. XVI., 1888–89, pp. 117–119).

Forbes, S. A. Note on an American Species of Phreoryctes. American Naturalist, May, 1890 [Vol. XXIV.], p. 477.

EXPLANATION OF PLATES.

PLATE VI.

Fig. 1.—Ventral seta detached. × 120.

Fig. 2.—Ventral seta in its sac, with problematical gland (?) just behind its tip, and terminal portion of duct of nephridium in front. × 192.

Fig. 3.—Valves of dorsal vessel. × 328.

Fig. 4.—Diagram showing course of lateral vascular arches, and position of valves. × 36.

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Fig. 8.—Ciliated funnel of nephridium, and portion of anterior lobe of fatty body, with septum intervening. × 328.

Fig. 9.—Front view of ciliated funnel of nephridium. × 328.

Fig. 10.—Diagram showing form and position of fatty bodies. × 43.

Fig. 11.—Transverse section of alimentary canal and dorsal and ventral vessels, a short distance behind œsophagus. The outer cells form the chlorogon layer. × 192.

PLATE VIII.

Fig. 12.—Same as Fig. 11, but from central part of body. × 192.

Fig. 13.—Portion of wall of alimentary canal. × 328.

Fig. 14.—Gregarinæ,—one attached to wall of intestine. × 192.

Fig. 15.—Single-celled parasites from cœlom. × 328.

Beddard, F. E. On the Reproductive Organs of Phreoryctes. Ann. Mag. Nat. Hist., Ser. 6, Vol. I., No. 6 [June, 1888], pp. 389–395, 1 Pl. Abstracts: Jour. Roy. Micr. Soc. 1888, p. 579; Zoologischer Jahresbericht, 1888, p. 64, Verm.

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Fig. 4.—Diagram showing course of lateral vascular arches, and position of valves. × 36.

Fig. 5.—Ventral nerve cord in one somite, with ventral organ and lateral nerves. The figure shows also the thick longitudinal ventral muscle, the thin circular muscle layer, the hypodermis, and the cuticle. × 200.

PLATE VII.

Fig. 6.—Transverse section of nerve cord and ventral organ from anterior part of body, showing also portion of ventral longitudinal muscle, circular muscle layer, hypodermis, and cuticle. × 192.

Fig. 7.—Same as Fig. 6, but from central part of body. × 192.

Fig. 8.—Ciliated funnel of nephridium, and portion of anterior lobe of fatty body, with septum intervening. × 328.

Fig. 9.—Front view of ciliated funnel of nephridium. × 328.

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Fig. 15.—Single-celled parasites from cœlom. × 328.

PLATE VI.

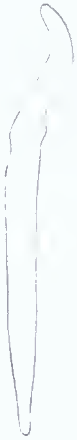


FIG. 1.

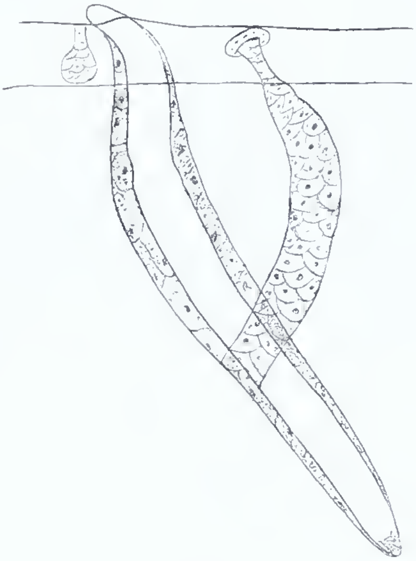
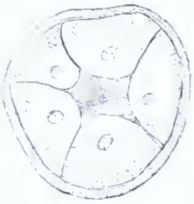


FIG. 2.



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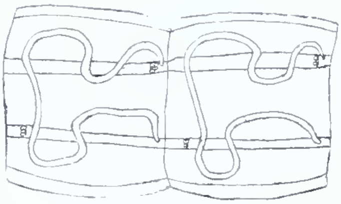

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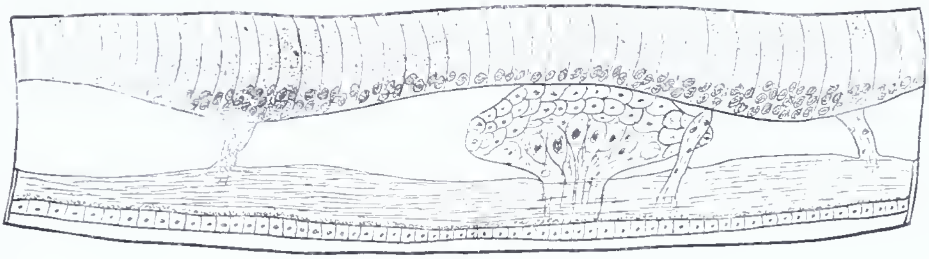


FIG. 5.

PLATE VII.

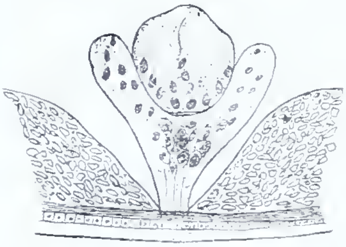
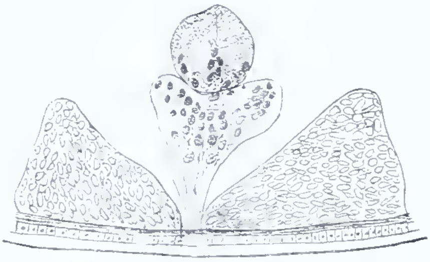


FIG. 6.



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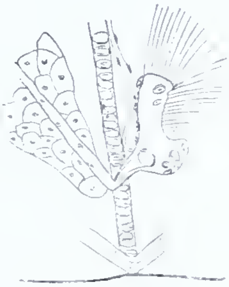

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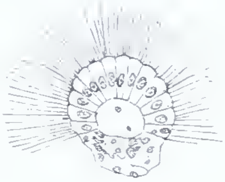

FIG. 9.

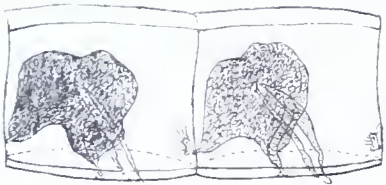

FIG. 10.

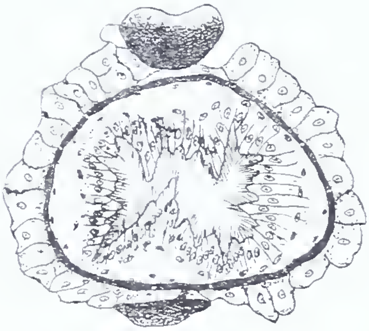

FIG. 11.

PLATE VIII.

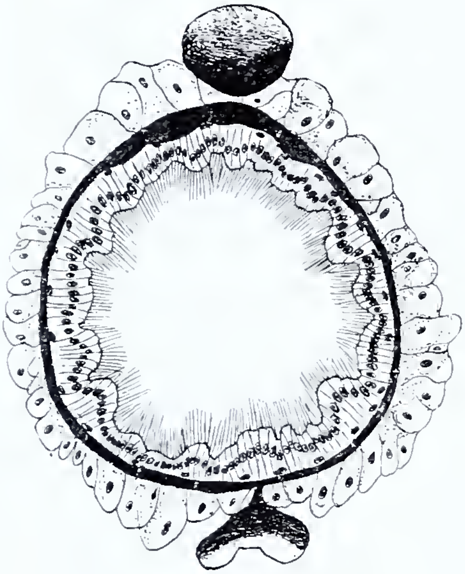

FIG. 12.

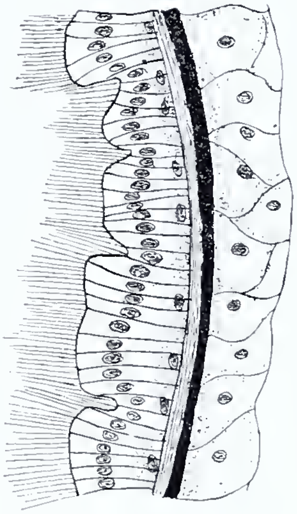

FIG. 13.

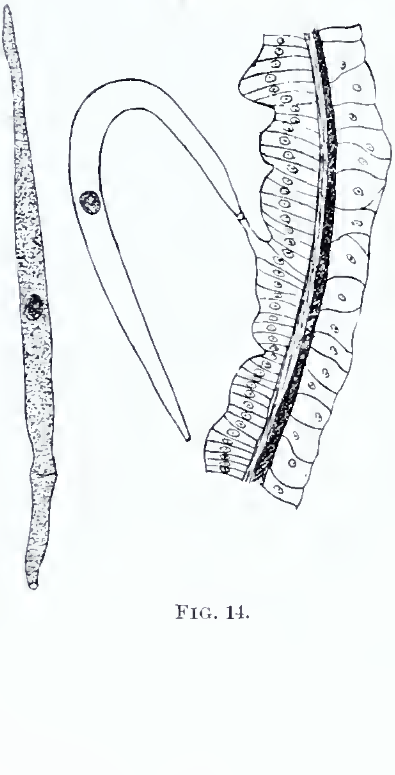

FIG. 14.

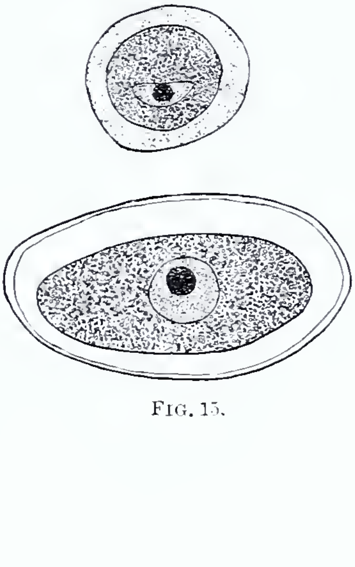

FIG. 15.

ARTICLE VIII.—*An American Terrestrial Leech.* By S. A. Forbes.

Our common land leech was first obtained by me in April, 1876, at Normal, McLean County, Illinois, where it was dug up in a house garden, about a dozen rods from the nearest rivulet. An example sent the following year to Prof. A. E. Verrill, with some remarks on its superficial characters, was by him identified provisionally and with some hesitation as his *Semiscolex grandis*, originally described* from three aquatic individuals obtained from Lake Huron, Lake Superior, and West River, Connecticut. I have now, however, fifty-six specimens of this leech, all from the earth in Central Illinois, some of them half a mile or more from water, and representing collections made at different times from April, 1876, to June, 1890; while, on the other hand, it has not once occurred in the course of a large amount of aquatic work done in the same regions during these fifteen years. It has, moreover, constant characters which clearly distinguish it from *Semiscolex grandis*, as far as one may judge by a comparison with Verrill's description, and I do not doubt that it is distinct.

Its only known food is earthworms of various genera, and these it swallows entire, as I have repeatedly found by dissection, and demonstrated likewise by feeding experiments on leeches in captivity.

From the fact that all my specimens were obtained during the early months of the year,—from March to June,—it is probable that this leech, like the earthworm, penetrates to considerable depths during the midsummer drouths.

DIAGNOSIS.

Semiscolex terrestris, Forbes.† This is one of the largest of our leeches, my contracted alcoholic specimens reaching a length of seven inches, a width of three fourths and a depth of three eighths of an inch. In form, it is heaviest posteriorly, being widest at about the eighth annulus in front of the acetabulum, but tapering very gradually or scarcely at all thence forward to the anterior fourth, and thence more rapidly to the mouth. Its transverse section is depressed oval, flattened beneath, the margins of the body obtuse.

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* Synopsis of the North American Fresh-Water Leeches. By A. E. Verrill. U. S. Commission of Fish and Fisheries. Part II. Report of the Commissioner for 1872 and 1873, p. 672.

† American Naturalist, vol. xxiv., 1890.

The color is sooty drab, varying to plumbeous black, somewhat lighter beneath, uniform in tint, and quite without spots or mottlings of any sort. A darker median longitudinal stripe, very conspicuous and well defined, is almost invariably present; a paler marginal stripe often approaching buff, little less constantly so; and a ventral submarginal stripe of the same color as the median dorsal one likewise quite frequent. The surface is everywhere smooth, and I find no external trace of segmental papillæ.

There are ninety-nine complete annuli from the mouth to the posterior sucker, four imperfect annuli in the cephalic lobe (counting the one bearing the first pair of eyes as the first), and one such just before the vent — one hundred and four in all. All the perfect annuli are very distinct except the first two, which, while well distinguished dorsally, are almost, but not quite, fused beneath to form the posterior border of the mouth. In front of the first annulus is the upper lip, divided by a delicate median groove. There are, consequently, eleven such grooves meeting the margin of the mouth, its posterior boundary being formed by the undivided ventral portion of the fifth annulus. The eyes are ten in number, placed upon the first, second, third, fifth, and eighth annuli, representing somites one to five. The acetabulum is broad oval, wider than long, and measures about 10 mm. in its greatest diameter. The vent is large and surrounded by irregular radiating grooves.

The first nephridial pore is at the anterior margin of the tenth complete annulus,— the fourteenth in all,— and the last or seventeenth pore at the anterior margin of the ninetieth ventral annulus,— the ninety-fourth of the full series. These pores open on the ventral surface just within the dark ventral line, and consequently at some little distance from the margin of the body. The male sexual opening is on the posterior part of the twenty-eighth entire annulus and the female opening on the thirty-third.

Within the buccal cavity is a prominent circular fold. Maxillæ three, minute, .5 mm. to .66 mm. in length, each with an armature of twelve to fifteen bicuspid teeth. The pharynx presents ten to fifteen longitudinal folds, the number varying in different parts, with an average of twelve or thirteen.

I have seen no specimens of *Semiscolex grandis*, Verrill, but draw from the author's description distinctions in the number of the annulations ("about ninety" in *grandis*), the presence of maxillæ, the positions of the sexual orifices (in *grandis* in the twenty-fifth and thirtieth annuli respectively), and in the color markings,—*grandis* being, in Verrill's specimens, without stripes, but spotted or blotched with dark.

ANATOMICAL NOTES.

The genus Semiscolex, to which this species unquestionably belongs, was described by Kinberg* in 1867, but has been since very little discussed. It is not, in fact, again referred to in any literature within my reach, except by Verrill, in the third volume of the American Journal of Science (1872) p. 136, and in the Report of the U. S. Fish Commissioner for 1872 and 1873, p. 671. It is clearly closely allied to Aulastoma, Moqu., and seems to me but doubtfully distinct. The following anatomical details will help to an understanding of the relations of our species :

The alimentary canal is clearly distinguishable into five regions. The first is the pharynx (closely invested by muscles), which extends to about the twenty-second annulus from the mouth. The second is the so-called œsophagus and proventriculus, a simple cylindrical tube without lateral sacculi, terminating opposite the fourteenth ventral ganglion (counting the subœsophageal as the first), where it gives off two long, slender sacculi which extend backward beside the alimentary canal to the last testis. At the point of origin of these sacculi, the canal becomes very much enlarged, the three remaining divisions being of nearly equal length. The third region, the digestive stomach of Bourne, is large and thin-walled, its cavity presenting about four regular constrictions, and its mucous membrane being conspicuously and finely rugose. The next section, the intestine proper, is smaller, with minute, irregular, and much less conspicuous rugosities ; while the last section, the rectum, is about the diameter of the stomach, with a smooth mucous membrane. It passes backward without narrowing, rapidly rounding directly into the large anus.

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* Ofversigt af Kongl. Vet. Akad. Forhandlingar, xxiii, p. 357.

The testes are ~~ten~~ 20 in number in the specimens examined. The penial sheath is very long, extending from opposite the seventh ventral ganglion (where it is surrounded by the *glandula prostatica*) backward to a point opposite the ninth ganglion. Here it bends abruptly forward upon itself and passes to its external opening beneath the sixth ganglion. Immediately in front of the *glandula prostatica* lies the glandular part of the seminal vesicle of the left side, that of the other side being just opposite. Forward from this runs the thick-walled, shining *ductus ejaculatorius*, continued posteriorly as a slender, somewhat contorted tube which meets its fellow of the right side as this comes under the nerve cord just behind the sixth ganglion, the two then running in company to the base of the penial sheath.

The ovaries are small, nearly spherical, and lie closely approximated on each side of the nerve cord, immediately behind the seventh ganglion. The common oviduct passes first through a pyriform *glandula albuginea*, the apex of which reaches backward to the eighth ganglion, and then, at first small but presently much enlarged, runs backward somewhat deviously to the ninth ganglion, where it turns directly forward and continues unchanged to its orifice.

The subœsophageal ganglion is closely approximated to the next behind, the second and third ganglia are about half as far apart as the third and fourth, and these about two thirds the distance of the fourth and fifth. The last four ganglia are likewise much approximated, the posterior one being very large, and sending off several pairs of branches.

ARTICLE IX.—*A Preliminary Report on the Animals of the Mississippi Bottoms near Quincy, Illinois, in August, 1888.* PART I. BY H. GARMAN.

THE LOCALITY.

The peculiar features of the waters examined while with the Fish Commission at Quincy, in August, 1888, are reflected in the character of the collections taken from them. The locality is not one which would be selected by the naturalist as likely to yield a great variety of species. The waters are too much alike and are too much at the mercy of the Mississippi River for that. It is a locality, however, that is eminently characteristic of the Mississippi Valley, and one that is calculated to yield a fauna equally characteristic of certain influences which the great stream exerts upon its denizens.

The flood-ground of the Mississippi River at Quincy will average six miles in width from bluff to bluff and extends very nearly north and south. The river reaches the bluff on the Missouri side at the village of LaGrange, nine miles northwest of Quincy. From LaGrange it flows southeast in a direct course to the bluffs upon which Quincy stands. As this part of the river is but little more than a mile in width, it will be seen that extensive bottom-lands must lie on both sides of it between LaGrange and Quincy. On the Missouri side these bottoms form an extended and continuous body of land,—all wooded except the upper part, which is known as Lone Tree Prairie.

It is to the forest bottom-lands on the Illinois side northwest of Quincy that we wish to call especial attention, since it was upon them that most of our work with the Fish Commission was done. Unlike the Lone Tree Prairie region, they are cut up by channels into numerous separate bodies of land, upon some of which the water rises in spring, and leaves, as it subsides, numbers of lakes and ponds, some permanent, others transient. Opposite LaGrange some of these tracts are permanently detached from the main-land and form a group of large forest-covered islands. Including the channels between these islands, the river here has the unusual width of nearly three miles. Between the islands and the bluff is a fertile bottom-land, now protected from inundation by the Indian Grave levee. From this, the widest part, the Illinois bottoms become gradually narrower towards Quincy, just as those of the Missouri side do towards LaGrange, and terminate in a point known locally as the "tow-head." All of the lower part is without levee protection and is separated from the neighboring bluff by Quincy Bay, a narrow inlet which opens to the river at the tow-head, and extends thence northward close along the bluff for about three miles.

THE RIVER.

As has been said, the river averages about one mile in width. While the general course between LaGrange and Quincy is nearly direct, the low-water channel makes several bends. It runs along the face of the bluff at LaGrange, then turns southeast, at length reaching the Illinois side close to the south end of the LaGrange group of islands, and strikes the Illinois bottom-land about three miles north of Quincy, cutting down the banks vertically, undermining and carrying away the trees and threatening even to cut across to the bay. It then turns toward the Missouri side again and reaches it two miles below. Thence it is deflected towards Illinois, and passing close along the south end of the tow-head, follows the bluff along the lower part of Quincy. It flows at the rate of three miles an hour. These bends in the low-water channel are not specially noticeable to the landsman at high water, since the river then fills its whole bed. In the latter part of summer, during most seasons, the water subsides to such an extent that a good deal of the extensive sand-bar which has accumulated in each bend becomes exposed, and the river is confined to its low water channel. One such bar occurs in the bend west of the lower end of the Illinois bottom-land, and another on the Missouri side opposite the point at which the current strikes the same bottom-land above. In the river proper no serious work was attempted, because of the protracted high water due to heavy falls of rain in early summer. This was going down when we reached Quincy in the latter part of July, and the sand-bars in the bends began to appear soon after; but in August heavy rains in the northwest caused a rise which again covered them. This condition of the river had a decided influence on the abundance and variety of animals, both in the lakes and sloughs and in the river itself. It will be referred to again.

BEAR CREEK.

This stream winds down through all the northern part of the Illinois bottom-land, and after giving off several branches to the Mississippi River on the west, reaches the upper part of Quincy Bay, into which it formerly opened. At present the building of the Indian Grave levee across it, a short distance within this mouth, has closed the outlet, and the only water discharged into the bay passes through a sluice-gate. The lower part of the creek is now, therefore, little more than a slough. This was well filled with water when examined, and a small stream issued from a break which, during a recent inundation, it had made in the levee. The banks are steep, as a rule, as would be expected from the alluvial character of the soil through which the channel is cut. The shores are commonly wooded, and originally, doubtless, the whole of the neighboring region was covered with forest. The bottom is extremely muddy, and from the abundance of snags and brush lodged in its channel and its stagnant water, it is not an inviting collecting ground for the naturalist.

BALLARD SLOUGH.

This is a channel which has been cut obliquely across from the Mississippi River to Bear Creek, reaching the latter about a mile and a half northwest of the point at which the levee crosses the creek. Its river end, covered by the levee, is a half mile further north, and the length of the slough is probably not far from one and a half miles. It was, when visited, quite shallow and extremely muddy, and varied greatly in width at different portions, sometimes expanding into pools of considerable extent, and again contracting to fifteen or twenty feet in width. It was not continuous at this time, and probably during most seasons dries up in great part before the close of summer.

HARKNESS SLOUGH.

Harkness Slough is a channel which extends almost exactly parallel with Ballard Slough, and lies a quarter of a mile further south. It is very narrow,—not fifty feet across in much of the lower part of its course; has steep banks; forms some rather deep pools; and is, like Ballard Slough, extremely muddy. A dense growth of trees lines its banks. It was continuous as far as followed towards the Mississippi River (although greatly reduced at some points), and, judging from the current, was doubtless yet connected with the river. Still there can be no doubt that it commonly dries up largely in summer.

GOOSE LAKE.

An eighth of a mile south of the outlet of Harkness Slough into Bear Creek, is a wide opening on the east into Goose Lake,—an open sheet of water, from the shores of which much of the forest has been removed. It becomes shallower and its bottom more sandy towards its south end, from which a channel extends which formerly put it into communication with the bay, three quarters of a mile below.

LIBBY LAKE.

This name was given me by one of the fishermen for a long, narrow pool on the west side of Bear Creek about midway between the outlet of Goose Lake and the Bear Creek sluice-gate. It is not named on any map at hand. It was in some respects very different from any other water in which collections were made. The water was quite deep, and, for the situation, unusually clear and cool, and gave promise of a growth of aquatic and sub-aquatic vegetation at the edges later in the season. It is scantily edged with willow and button bush and a few other trees and shrubs.

QUINCY BAY.

The four bodies of water just described are within the levee. Quincy Bay extends from the levee where this reaches the Illinois bluff (about three miles and a half north of Quincy) directly southward along the foot of the bluff to the tow-head opposite the center of the city, at which point it opens to the river. It varies little in width and will average perhaps a third of a mile. It is little more than an inlet of the Mississippi containing back-water during the latter part of the year, the water in much of it becoming then very shallow and the current almost disappearing. During the month spent at Quincy this year, the water did not reach its usual low stage, and the current due to waters received from Bear Creek, and the sloughs, creeks, and springs, was sufficient to keep the bay quite clear of the algæ which would otherwise have appeared upon it. Its bottom is commonly muddy and no promise of other aquatic vegetation could be seen in it. It is edged with woods quite continuously on the west, and on the east also there is some growth of forest where the strip of level soil between the bay and the bluff gives room for it.

WILLOW SLOUGH.

This narrow channel extends obliquely across from the river to the bay outside of and parallel with the levee. It enters the bay about one and two thirds miles above the south end of the tow-head, and leaves the river a little over four miles north of the same point. Its length is about two and two thirds miles. At high water a current from the river sweeps through and reaches the bay; but at the time it was seen but little water ran out; and in the lower part of its course it consisted of stretches of water connected by narrow rivulets. Some of the pools were of considerable depth. The bottom is commonly muddy, but occasional beds of sand occur. There was no vegetation.

WOOD SLOUGH.

Wood Slough is also a narrow channel extending obliquely across the lower part of the Illinois bottom-land from river to bay. It formerly entered the bay opposite the north end of Quincy, but the building of an embankment for a railroad bridge cut it off from this outlet so that it now turns west at its lower end and, running along the embankment, empties into the river again. Throughout its course it is very nearly parallel with the west shore of the bottom-land, in some cases being only a few rods away from the river. The river enters it four miles northwest of Quincy, and a mile and a half below this it breaks through the bank to the river again, so that at low water its lower part may not be continuous with the rest. It is perhaps three and a half miles long,—a narrow, muddy ditch of shallow water, completely devoid of vegetation, and containing such animals only as are so unfortunate as to be entrapped in it by the subsiding spring floods.

CLAUS LAKE.

This lake is a small temporary pool in the bottom-land about one fourth mile east of the north division of Wood Slough. It is very shallow,—at no place up to the mens' waists; has the usual muddy bottom; and lacks vegetation.

DEAD MAN'S SLOUGH.

Dead Man's Slough is a name applied by the fishing crew to a shallow, muddy pool in the woods about a quarter of a mile from the river above the north end of Wood Slough.

MOSS LAKE.

Moss Lake, on the southern part of Long Island, the largest of the LaGrange group, is very similar to the last two in general character, being an isolated pond in the woods. It is, however, much deeper than they, and its water is cooler and clearer. It is surrounded by a growth of hickory, elm, sycamore, and grape. Its length is less than a fourth of a mile, and its width from 150 to 200 feet. No aquatic vegetation was growing in it when it was seined in August.

LILY LAKE.

Lily Lake is one of a group of three lakes which lie between the lower end of Wood Slough and Quincy Bay. They have a common outlet during the fore part of the summer through Wood Slough. Lily Lake is the smallest of the three, and lies only a few rods from the west shore of the bay. It is an oval pond of shallow water full of the pads of water chinquepin, and is the only water from which I collected that contained a growth of vegetation. It is pretty well protected on the north and west by forest, which probably prevents to some extent the ravages of overflows.

LONG LAKE.

Long Lake, the second of the group, lies a short distance northwest of the preceding. It is nearly three quarters of a mile long, and is a narrow body of rather deep water surrounded by forest.

BROAD LAKE.

West of the lower half of Long Lake is the third lake of the group. It is broad and shallow, and when visited consisted of a series of detached pools with sloping bottoms of mud so deep as to make it extremely difficult to drag a seine.

CEDAR CREEK.

This is a small rapidly flowing creek which comes from the east and, cutting through the bluff, enters the bay half a mile above the city limits. At its mouth it has deposited a large bed of alluvium through which one sinks to his knees in wading. A short distance from the bay it becomes rocky, and between the bluffs and in the upper part of its course flows over almost solid limestone. When visited, it was moderately low, and in places were shallow pools connected with each other by narrow reaches along which the water rushed with considerable speed. The water is quite clear notwithstanding the sewage which it receives; yet the influence of the latter is seen in the comparative scarcity of aquatic life for some distance back of the bluff.

OTHER WATERS.

The only situations other than those described above, in which collections were made, were a small creek without name just above Quincy, which is similar to Cedar Creek in every repect except its smaller size, and a muddy pond near the bluff at the southern limit of Quincy.

It was from the lakes and sloughs thus briefly described that the material was obtained upon which this paper is based. Omitting Cedar Creek, the bay, and the river, they have much in common. All were, or are now, subject to overflow by the Mississippi. Since the Indian Grave levee was built, the waters within it,—Bear Creek, Harkness and Ballard Sloughs, and Libby Lake,—have not commonly been subject to inundation, —a fact which explains certain special features of the collection taken from them. The condition of the pools with reference to the river was not a usual one. A late rise in the river had flooded them after the spring freshets had subsided, and kept open the communication with the river much longer than would otherwise have been, thus helping the large fishes to escape from them after spawning, and doubtless carrying away hosts of the smaller organisms which had appeared in the pools. All have very muddy bottoms. In most, this mud was nearly knee deep, and made seining very difficult and disagreeable. In some places deposits of mud were of such recent origin and were so loose that it was unsafe to venture into them. Aquatic vegetation was almost wholly lacking. A scant growth of filamentous algæ was occasionally seen, but in nothing like the quantities in which it occurs in ordinary stagnant or quiet water. In Lily Lake alone there was a rank growth of aquatic vegetation. Here a permanent growth of water lilies (*Nelumbium luteum*) had become established, and to the under sides of the lily pads was attached a scant growth of filamentous algæ. This absence of vegetation is directly traceable to the overflows, since these disturb the bottoms of the pools, displacing the silt in some places, depositing fresh material in others, and dislodging and carrying away the plants which become established during the intervals between floods. The water was not very deep at this time, but of course varied with the river. It could be waded in most places by the men. It was deepest in the larger pools, such as Long and Broad Lakes, and here the temperature was tolerably constant. In the sloughs, where the water was shallow, it often became very warm, and during a few days of unusually high temperature became at the edge of these so hot as to be scarcely bearable.

ANIMAL LIFE.—MAMMALS AND BIRDS.

With this sketch of the surroundings we pass to the animals themselves. Of course mammals were not to be looked for on land so recently covered with water, and no trace of the presence of muskrats, even, was noticed. The raccoon, however, is said to remain on the flooded ground at all times, resorting to the trees, and probably often fasting, when surrounded by water. These animals were common about the sloughs, as was shown by the prints of feet, and doubtless depend to some extent on the fishes and other animals there crowded together. Fishes thrown upon the shore were generally devoured by them before the next morning. In the latter part of August they were plainly depending largely on wild grapes for food.

Birds were at no time abundant. A few kingfishers, a solitary green heron, or a couple of spotted sandpipers (*Tringoides macularius*), were about all that were commonly seen during a day's work. As the season advanced these became a little more abundant from accessions of migrating birds to their numbers. At one time a flock of about forty white pelicans appeared for the greater part of a day on the Missouri sand-bar opposite Wood Slough, but were driven away by gunners and did not again appear. An occasional troop of cormorants was seen, a single blue heron, a dab chick (*Podilymbus podiceps*), and two half-grown ducks, one of which was brought in by the seine. When the wild grapes ripened, the bottom-land was invaded by a good many of the smaller birds which were not often seen there before. Among these, robins, red-headed woodpeckers, and blue jays were conspicuous, though I cannot say that the two latter were attracted by the grapes. One other bird deserves mention as, from the numbers in which it occurs, it must have an important influence upon the insect life of the waters. Certain parts of the bluff presented extensive vertical surfaces of exposed clay, and bank swallows, in great numbers, had excavated burrows in this for nests. In places these exposed surfaces were honey-combed with the burrows. During quiet afternoons and evenings the swallows spent a good deal of time skimming the surface of the water of the neighborhood. Among them was noted occasionally, the white-billed swallow (*Tachycineta bicolor*); but most seemed to be the bank swallow (*Clivicola riparia*). There can be no doubt that the destruction of winged insects from the water by the hundreds of swallows annually reared in these banks is very great.

REPTILES.

With one exception, serpents, even of the aquatic kinds, were not seen. I presume they are not able to maintain themselves on the bottom-land during inundations. A single *Regina leberis* was seen for several days lurking about fish boxes at the headquarters of the Fish Commission. The absence of vegetation may also have had something to do with the absence of serpents, since they prefer places in which they are not so completely exposed to observation. The locality was certainly calculated to furnish an abundance of food to the fish-eating species.

Turtles were present in great numbers. They were especially common in the more retired pools when these were first visited. Subsequent visits showed them in diminished numbers, either from their having migrated, or having learned to avoid the seine by burrowing in the mud. The egg-laying season was apparently past, so that no opportunity offered for studying the breeding habits of the species. I am informed that the eggs are sometimes gathered from sandy shores by hundreds, and used as food.

The following brief list includes most of the species of Chelonia which occur in Illinois. Doubtless some of the other Illinois species will also be found here when the locality is more thoroughly explored.

PAINTED TURTLE (*Chrysemys belli*, Gray).

This turtle was rather common in the sloughs, but was not seen elsewhere. Adults are not easily distinguished from the related *C. marginata;* but I believe none of the latter occurred in the sloughs.

Pseudemys elegans, Wied.

Frequent in sloughs.

Pseudemys troostii, Holbrook.

Rare. Three examples from Moss lake, on Long Island, in the river. A strong, irritable species.

Mud Turtle (*Malacoclemmys lesueuri*, Gray).

Equally common with the next species and much like it in habit. The two are not discriminated by river men, and are known to them as mud turtles. Observed in most of the sloughs and in the river and bay.

Mud Turtle (*Malacoclemmys geographicus*, Lesueur).

This and the preceding species probably constitute more than half of the turtles which one sees on the partly submerged trunks of trees and on sunny banks along the river and sloughs. Scores may be seen on bright days sunning themselves on the edges of the log rafts in the upper part of the bay. They are not used as food, though it is sometimes claimed that the flesh is palatable.

Alligator Snapper (*Macrochelys lacertina*, Schw.).

This species is said by fisherman and sportsmen to occur here occasionally.

Snapping Turtle (*Chelydra serpentina*, Linn.).

Occasional in sloughs and lakes. Those taken were large and very fat. It is prized as food.

Soft-Shell Turtle (*Aspidonectes spinifer*, Lesueur).

Abundant in river and not uncommon in the sloughs. Fishermen sell readily those caught in their seines.

Soft-Shell Turtle (*Amyda mutica*, Lesueur).

Common in the river, but less abundant in sloughs than the preceding. Reaches a length of 8 to 10 inches. It is used as food.

AMPHIBIANS.

Amphibians evidently cannot maintain themselves on these bottom-lands. They were very rare; and probably the few seen had made their way in from the higher land within the levee. A few half-grown leopard frogs (*Rana virescens*, Kalm) were taken in the woods under logs, and at the edges of sloughs. One full grown example was taken at the edge of Claus Lake August 10. A single *R. catesbiana*, Shaw, was heard within the levee in Bear Creek. The cricket frog (*Acris gryllus*, LeConte) was frequently seen at the edges of the water, but was by no means common. Two young toads about half an inch long were taken at the edge of Lily Lake August 7, and another example 1.25 inch long was taken August 15 at the edge of Willow Slough. The former had probably grown from spawn deposited in the water after the late floods. They were found on the side of the bottom next the bluff. It may be that a few adults succeed in avoiding the current on this side and remain here; but they are certainly rare. Not a single tadpole was noticed in any of the bottom-land sloughs and lakes; but a few small tadpoles of toads were noted in shallow pools of Cedar Creek. All these amphibians were feeding on terrestrial insects,—chiefly beetles belonging to the families Carabidæ, Staphylinidæ, and Heteroceridæ, together with a small fly, and leaf-hoppers of the family Jassidæ. One cricket frog had eaten a single aquatic larva (the Acilius described below). There was little difference in the food of the different species from any one locality. Along Cedar Creek a small black fly, which was common on moist sand, was eaten largely.

FISHES.

The fishes taken from the sloughs and lakes of the bottom-land at Quincy, may be placed in three groups: creek fishes, pond or slough fishes, and river fishes. To the creek fishes belong most of the minnows, the sand darters, and the common sucker,—altogether about half as many species as there are in each of the two remaining groups. The individuals belonging here were probably less than one per cent. of those taken from the pools. This scarcity was due in some measure to the abundance of predaceous fishes in these waters; but the species of this group taken were mostly such as are ordinarily found common in small creeks, and were probably only stragglers from the great body of individuals which live in such streams. Several of the minnows, however, deserve to be placed among river fishes as far as fitness for life in the river is concerned. Such species as *Hybopsis amblops, Notropis atherinoides, N. jejunus*, and *Hybognathus nuchalis*, though occurring in small streams, generally prove abundant in our rivers, and are certainly perfectly at home there.

I have considered as pond and slough fishes, such as the bull pouts, the top minnows, the two pickerels, the two croppies, the several species of sunfishes, the large-mouthed black bass, and the ringed perch. The members of this group were commoner in the sloughs than were those of the preceding group, but were not as abundant in species or individuals as the next. In the lakes and sloughs outside the levee, probably these pond fishes did not constitute more than one fifth of the individuals taken; but inside the levee they composed one half of those taken in all situations. Some of them were evidently breeding in these protected waters, and I do not think any member of the group was doing so in the sloughs of the lower bottom-land.

The third and largest group includes river fishes, such as gars, dogfish, channel cat, morgan cat, shovel fish, buffalo, carp, several minnows, the Ohio shad, pike, perch, striped bass, white bass, red-spotted sunfish, and the white perch (Aplodinotus.) These fishes must have constituted in the neighborhood of four fifths of the individuals in the sloughs and lakes outside the levee. A number of them, notably the hickory shad and the red-mouthed buffalo, occurred there in prodigious numbers. As a rule, these species became gradually less and less common as one went north and away from the river, and accompanying this diminution in the numbers of river fishes was a gradual increase in the numbers of pond fishes. There was, in fact, an overlapping of the two groups in the bottom-land, the river fishes being most abundant in the sloughs near the river, and the pond fishes, within the levee and to the northward. Still, several river fishes were very common inside the levee. Evidently not all of the river fishes taken in the sloughs breed there. Such species as the morgan catfish (Leptops), the shovel fish, the minnows, and the red-spotted sunfish (*Lepomis humilis*) had probably wandered here from the river during high water and had been confined when the water became lower. Most of the remaining river fishes had, I think, been spawned on the flooded bottoms. The abundant young of gars, buffalo, carp, hickory shad, pike perch, and white bass in the temporary pools are evidence of this.

FAMILY SCIÆNIDÆ.

SHEEPSHEAD, WHITE PERCH, (*Aplodinotus grunniens*, Raf.)

The young of this fish, varying from 2.50 inches to 4.50 inches in length, were frequent in most of the sloughs and lakes. These are, in all probability, the young of the season. If smaller ones existed in the sloughs, they would certainly have been captured in the seine used by the Fish Commission (a quarter-inch mesh). This species was more abundant inside the levee than in the pools on the lower part of the bottom-land, and was especially common in inlets along the lower part of Bear Creek and in Goose Lake. On a small sand bar in Bear Creek, at the mouth of Harkness Slough, more were taken than at any other one place. No specimens longer than 4.50 inches were taken from the sloughs and pools, so far as I know. In the bay and river, large ones were very common; and probably half of the fishes taken during August with hook-and-line from barges and river banks were of this species. It seems quite at home in the swiftest current of the river, and was caught with minnow bait from banks upon which the current strikes with a force which it would seem no animal could withstand. The largest example seen would have weighed about one pound. The local name for the fish is perch; and it is considered one of the best of food fishes.

Localities: Ballard Slough, Harkness Slough, Bear Creek, Goose Lake, Quincy Bay, Claus Lake, Willow Slough, Lily Lake, Broad Lake, Wood Slough, Mississippi River.

FAMILY SERRANIDÆ.

STRIPED BASS, YELLOW BASS (*Morone interrupta*, Gill),

Young were frequent in certain of the sloughs and lakes, but were not seen elsewhere. In the northern part of Broad Lake and in small isolated pools above it, they were quite common. Examples preserved vary from 1.75 inch to 4.50 inches in length.

Localities: Ballard Slough, Harkness Slough, Goose Lake, Dead Man's Slough, Claus Lake, Willow Slough, Lily Lake, Broad Lake.

WHITE BASS, ROCK BASS (*Roccus chrysops*, Raf.).

This fine species was more abundant than the striped bass, and ranged in a greater variety of situations. I saw it caught from the swiftest current of the river. Only young ranging from 2.50 to 5 inches in length were found in the sloughs. It was nowhere common except in the upper part of Broad Lake and in the pools which had recently been in communication with it.

Localities: Ballard Slough, Bear Creek, Goose Lake, Dead Man's Slough, Moss Lake, Willow Slough, Long Lake, Broad Lake, Wood Slough.

FAMILY PERCIDÆ. (PERCH.)

SAUGER, JACK SALMON (*Stizostedion canadense*, Smith).

Young frequent in lakes, varying from 3 to 5 inches in length. No adults seen.

Localities: Goose Lake, Claus Lake, Lily Lake, Long Lake, Broad Lake.

WALL-EYED PIKE (*Stizostedion vitreum*, Mitch.).

Young frequent in most of the sloughs and lakes; sometimes abundant. Ranged from 2.50 inches to 6 inches in length. Frequently with large, conspicuous, dusky blotches.

Localities: Harkness Slough, Goose Lake, Willow Slough, Lily Lake, Long Lake, Broad Lake, Wood Slough.

COMMON RINGED PERCH (*Perca flavescens*, Mitch.).

Young ringed perch were occasionally seen in the bottomland lakes. Those captured ranged from 2.75 to 3 inches in length. In Libby Lake, within the levee, these fishes were abundant, — a fact which was noted with surprise, as they had not hitherto been found common in the State away from the northern part. Those taken from this lake differed from the northern lake form in being rounder; and also especially in color. When taken from the water they were almost uniformly olive green above, with white belly. As they died, faint blackish bars gradually appeared. Mr. Bartlett tells me that he has transplanted perch to this locality,—a fact which probably accounts for the abundance of the fish in Libby Lake.

Localities: Libby Lake, Dead Man's Slough, Long Lake, Broad Lake.

Sand Darter (*Etheostoma jessiæ*, Jor. & Brayt., var. *asprigene*, Forbes).

Judging by the number of specimens of this little fish taken, it is not common here, although parts of Willow Slough are well suited to it.

Four examples, Willow Slough; one large brightly colored example, Broad Lake; one example, Lily Lake.

Sand Darter (*Etheostoma phoxoeephalum*, Nelson).

Occasional in Wood Slough. Excepting a single example from Willow Slough, it was not seen elsewhere.

Blackis-ded Darter (*Etheostoma aspro*, Cope & Jor.).

One small example approaching *E. phoxoeephalum* in colors, was taken in Wood Slough, July 30.

Log Perch (*Etheostoma caprodes*, Raf.).

This was the most abundant darter collected. It was quite common in Willow Slough, Long Lake, Broad Lake, and Wood Slough.

Johnny Darter (*Etheostoma nigrum*, Raf.).

An immature example from Willow Slough was the only one seen.

Family Centrarchidæ. (Sunfishes).

Large-mouthed Black Bass (*Mieropterus salmoides*, Lac.).

The young of this bass were moderately common in all the sloughs and creeks. Examples of considerable size were occasionally taken, showing that this species does not necessarily leave the sloughs after spawning. One example brought in by the net must have weighed seven pounds or more. The smaller examples, which are of interest as in all probability the young of the season, ranged from 2 to 3 inches in length. Between these and the larger ones were various intermediate sizes representing probably three or four generations.

Localities: Ballard Slough, Harkness Slough, Libby Lake, Moss Lake, Dead Man's Slough, Claus Lake, Willow Slough, mouth of Cedar Creek, Lily Lake, Long Lake, Broad Lake.

SMALL-MOUTHED BLACK BASS (*Micropterus dolomieu*, Lac.).

A single young specimen 2.12 inches long, was taken in Willow Slough August 7. The locality is somewhat unusual for this species. It is certainly not common in the water collected from. Mr. Bartlett informs me that it was brought here some time ago by the State Fish Commission.

COMMON SUNFISH (*Lepomis pallidus*, Mitch.).

Rare in the temporary pools, becoming common in the deeper water of Long and Broad Lakes; also quite common within the levee. The youngest examples taken ranged from 1 to 1.75 inch in length. Adults in breeding colors were caught in Long and Libby Lakes. Females contained ova as large as No. 12 shot. An old gentleman who has fished here for years tells me that in the days of the earlier settlers sunfishes, presumably of this species, were sometimes taken that weighed as much as four pounds.

Localities: Ballard Slough, Harkness Slough, Libby Lake, Dead Man's Slough, Moss Lake, Willow Slough, Lily Lake, Long Lake, Broad Lake, Mississippi River.

RED-SPOTTED SUNFISH (*Lepomis humilis*, Gir.).

This handsome little fish was quite common in sloughs and lakes,— more abundant than we have found it elsewhere in the State. Very few young were seen, and these were nearly mature. It is quite hardy, as is shown by the water it frequents, and may prove a desirable aquarium fish. All the adults taken differed from the descriptions of Drs. Jordan and Gilbert in having the opercular flap with a wide *white* margin instead of a red one. Immature examples have the opercular flap poorly developed and are marked in the sides with numerous small black dots, while the red of the adult is largely wanting.

Localities: Harkness Slough, Goose Lake, Moss Lake, Dead Man's Slough, Claus Lake, Willow Slough, Long Lake, Broad Lake, Wood Slough, pond at southern limit of Quincy.

RED-EYE, BLUE SPOTTED SUNFISH (*Lepomis cyanellus*, Raf.).

Two examples about 3.50 long, taken in Goose Lake, Aug. 13, were the only ones seen.

WARMOUTH, RED-EYED BREAM (*Chænobryttus gulosus*, C. & V.).

A few young, about 1.50 inch long, were taken in most of the pools. Frequent in Libby Lake and Harkness Slough.

Localities: Ballard Slough, Harkness Slough, Libby Lake, Dead Man's Slough, Claus Lake, Lily Lake, Long Lake, Wood Slough.

PALE CROPPIE (*Pomoxys annularis*, Raf.).

The pale croppie was more abundant than we have found it elsewhere in the State away from Southern Illinois. This fact is one of a number which our fish fauna yields, illustrating the influence of the Mississippi River in extending the range of southern species northward immediately along its course. Young, from 2.25 to 2.75 inches long, were common; and between these and the largest taken (8 inches long) were a number of intermediate sizes. The species became a little more abundant in the more northern pools.

Localities: Ballard Slough, Harkness Slough, Goose Lake, Libby Lake, Moss Lake, Dead Man's Slough, Claus Lake, Willow Slough, Lily Lake, Long Lake, Broad Lake, pool at southern limit of Quincy.

DARK CROPPIE, CALICO BASS (*Pomoxys sparoides*, Lac.).

A little more abundant than the preceding species in the sloughs and lakes. Especially common in the more northern pools, but very generally distributed. Most of those seen were young, from 1.50 inch to 2 inches long. No adults were seen from pools outside the levee.

Localities: Ballard Slough, Harkness Slough, Goose Lake, Libby Lake, Moss Lake, Claus Lake, Willow Slough, Lily Lake, Long Lake, Broad Lake, Wood Slough, pool at southern limit of Quincy.

FAMILY ESOCIDÆ. (PIKES.)

PIKE, PICKEREL (*Esox lucius*, Linn.).

This species was not seen in most of the bottom-land sloughs. Probably more work in the pools and lakes within the levee farther north would have shown it common enough. It probably does not often leave its retreats among the vegetation of quiet water for the current of the river.

From Harkness Slough, example 12 inches long; Libby Lake, several examples 8 inches long ; Long Lake, one example ; pool south of Quincy, a half dozen small examples.

LITTLE PICKEREL (*Esox vermiculatus*, Les.).

Not common apparently. Seen only within the levee and in Lily Lake.

Harkness Slough, one example ; Claus Lake, occasional examples five inches long ; Lily Lake, four small examples.

FAMILY ATHERINIDÆ.

Labidesthes sicculus, Cope.

Probably more common in the sloughs than it seemed to be, as its slenderness permits it to pass through most seines when they are not encumbered with vegetation. The pools are exactly suited to it.

One small example, Long Lake ; four examples, Broad Lake.

FAMILY CYPRINODONTIDÆ. (TOP MINNOWS.)

BLACK-SIDED TOP MINNOW (*Zygonectes notatus*, Raf.).

Frequent and generally distributed, but only a few taken at any one time. Schools of about a half dozen individuals were frequently seen in the bay.

Localities : Harkness Slough, Quincy Bay, Willow Slough, Long Lake.

FAMILY CLUPEIDÆ. (SHAD.)

HICKORY SHAD, GIZZARD SHAD (*Dorosoma cepedianum*, Les.).

The bottom-land sloughs and lakes are pre-eminently the spawning ground of this fish. Young of the year, 1.50 to 2 inches long and still wearing the black shoulder mark, occur in countless numbers. Probably more than half of the individuals taken in the Fish Commission seines during the season are these young shad. The temporary pools on the lower part of the bottom-land were crowded with them. They were less abundant farther back, but were still very common in Libby

Lake, inside the levee. The adults, on the other hand, were usually scarce; but in the pool south of Quincy both young and adults were common,—a fact explained by the situation of the pool east of a railroad embankment and at a considerable distance from the river. The pool is consequently very early isolated, and the adults which make their way in to spawn are prevented from escaping. Predaceous fishes confined in the sloughs depend very largely on this shad for sustenance.

Localities: Harkness Slough, Libby Lake, Moss Lake, Dead Man's Slough, Claus Lake, Quincy Bay, Long Lake, Broad Lake, Wood Slough, pool south of Quincy.

OHIO SHAD (*Clupea chrysochloris*, Raf.).

Probably not common. The only specimens seen were a half dozen young, 2.62 inches long, from Moss Lake, Long Island, Aug. 14.

FAMILY CYPRINIDÆ. (MINNOWS.)

GOLDEN SHINER, BREAM (*Notemigonus chrysoleucus*, Mitch.).

Frequent. Abundant in Libby Lake, where examples 5 inches long were seen.

Localities: Harkness Slough, Libby Lake, Dead Man's Slough, Claus Lake, Long Lake, Wood Slough, pool south of Quincy.

Hybopsis amblops, Raf.

Common in Willow Slough and of large size, some examples measuring 4.5 inches in extreme length. Elsewhere taken only in Broad Lake and Wood Slough, from each of which one or two examples were obtained.

Phenacobius teretulus, Cope.

A single example of this variable minnow was taken from Broad Lake, August 9.

Notropis atherinoides, Raf.

Not found common except in Moss Lake and in the river. On the sand bars of the latter it is caught in numbers for bait. It was sometimes seen hurrying up stream near the shore against the force of the current.

Localities: Moss Lake, Mississippi River, Broad Lake, Long Lake.

Notropis jejunus, Forbes.

One example, Long Lake; eight examples, Broad Lake.

SHINER (*Notropis megalops*, Raf.)

Rare. Two small examples from Willow Slough, the only ones secured.

SPAWN EATER (*Notropis hudsonius*, Clinton).

Not common. One example each from Goose Lake and Long Lake.

Notropis cayuga, Meek.

The above name was assigned some time ago by Prof. Gilbert to numerous examples of a small minnow in the Illinois State Laboratory collection. Mr. Meek's description has not been seen, but a comparison of a single example of a fish obtained in Long Lake, with the specimens examined by Prof. Gilbert, shows this to be the same thing. The species bears a superficial resemblance to *Notropis heterodon*, but has a short, weak mandible, without pigment, and a complete lateral line.

Cliola vigilax, Baird and Girard.

Frequent in several of the pools.

Localities: Willow Slough, Long Lake, Wood Slough.

BLUNT-NOSED MINNOW (*Pimephales notatus*, Raf.).

Less common than the preceding.

Long Lake, Wood Slough.

SILVERY MINNOW (*Hybognathus nuchalis*, Ag.).

This species was common in the river, where with *Notropis atherinoides*, it was taken in numbers for bait. Throughout Cedar Creek, also, it was very abundant, and in the upper part of the stream was the only fish seen. In the sloughs and lakes it was not common.

Claus Lake, Willow Slough, Broad Lake, pool south of Quincy, Cedar Creek, Mississippi River.

GERMAN CARP (*Cyprinus carpio*, Linn.).

This hardy fish seems destined to become a permanent part of our fauna. Examples of good size were taken on a number of occasions, showing it to be widely distributed among the pools and lakes of the bottom-lands. A single specimen of the fully-scaled form was taken from Dead Man's Slough August 18. The food of an example from Broad Lake consisted of vegetation and mollusks, the former constituting two thirds of the material in the alimentary canal, and consisting of dead leaves and of seeds. The seeds were, as far as could be determined in a hasty examination, chiefly those of trees and weeds. Elm seeds, ragweed seeds and the seeds of Polygonum were noted. The Mollusca were partly thin-shelled clams with an occasional Sphærium, and partly snails, such as Physa and Lioplax. All the matter was apparently gathered from the bottom. No trace of crustacean or insect food could be detected.

Dead Man's Slough, Broad Lake, Quincy Bay, and pool south of Quincy.

FAMILY CATOSTOMIDÆ. (SUCKERS.)

RED HORSE (*Moxostoma aureola*, Les.).

Rare. Seen only on two occasions.

Moss Lake, five examples 5.50 to 6 inches long; Wood Slough.

RED HORSE (*Moxostoma macrolepidotum*, *Les.*, *var. duquesnei*).

Occasional young 4.50 to 12 inches long were taken.

Localities: Moss Lake, Willow Slough, Long Lake, Broad Lake, Wood Slough.

COMMON SUCKER (*Catostomus teres*, Mitch.).

Rare. Those taken were about six inches long.

Localities: Moss Lake, Wood Slough, slough south of Quincy.

CARP, RIVER CARP (*Ictiobus velifer*, Raf.).

Generally distributed but not very common, and nearly all young. Examples from 3.50 to 7 inches long were taken. Frequent in the slough at south edge of Quincy.

Localities: Harkness Slough, Bear Creek, Goose Lake, Moss Lake, Willow Slough, Long Lake, Broad Lake, Wood Slough, pool south of Quincy.

QUILL-BACK BUFFALO (*Ictiobus bubalus*, Raf.).

Not observed in any of the bottom-land pools outside the levee, excepting Broad Lake. The young from 3 to 5 inches long were rather common inside the levee. The only large examples seen were taken from the river, where they seemed to be moderately common. The young are easily distinguished from the young of *I. cyprinella* by their small, inferior mouth, compressed body, and pale colors,—especially of the pectoral and ventral fins.

Localities: Harkness Slough, Bear Creek, Libby Lake, Dead Man's Slough, Claus Lake, Broad Lake.

MONGREL BUFFALO (*Ictiobus urus*, Ag.).

In my field notes I have recorded the young of this fish as occurring in the slough at the south edge of Quincy. They were not seen elsewhere. Adults were common in the river, and were sometimes seen of large size. One was noted August 6 which weighed twenty and a half pounds.

Localities: Slough south of Quincy, Mississippi River.

RED-MOUTH BUFFALO (*Ictiobus cyprinella*, C. & V.).

Young 4 to 5.75 inches long were extremely common everywhere in sloughs and lakes. They differ from the young of *I. bubalus* in having a larger mouth, thicker body, and darker colors. The pectoral and ventral fins are blackish, whereas in the case of the quill-back buffalo they are pale. Most of the large buffalo taken from the river were of this species.

Localities: Harkness Slough, Bear Creek, Moss Lake, Dead Man's Slough, Claus Lake, Willow Slough, Long Lake, Broad Lake, Wood Slough, slough south of Quincy, Mississippi River.

FAMILY SILURIDÆ. (CATFISHES.).

Noturus gyrinus, Mitch.

Moderately common in sloughs and lakes.

Localities: Harkness Slough, Dead Man's Slough, Willow Lake, Lily Lake, Long Lake, Broad Lake, Wood Slough.

MORGAN CAT, YELLOW CAT (*Leptops olivaris*, Raf.).

This catfish was rare in sloughs and lakes. A single example 10 inches long from Willow Slough was the only one seen from water of this kind. It was abundant in the river, where specimens of ten pounds weight were frequently taken; and one was noted August 6 that would probably have weighed 18 pounds or more. I am informed that young dog-fish are used on trot lines as bait for this catfish.

BULL-HEAD (*Ameiurus melas*, Raf.).

The most common of the small catfishes in the sloughs. They seem to be gregarious when young and small schools were occasionally seen swimming slowly along in an aimless fashion in the bay. The examples taken measured from 1.25 to 2.75 inches in length. Adults were not seen.

Localities: Claus Lake, Wood Slough, Lily Lake, Long Lake, slough south of Quincy, Quincy Bay.

BULL POUT (*Ameiurus nebulosus*, Les.).

Not seen in most of the pools. Frequent and of large size in Dead Man's Slough.

YELLOW CATFISH (*Ameiurus natalis*, Les.).

Not common. Those seen were adults.

Harkness Slough, one large example; Moss Lake, several large examples; slough south of Quincy, a few.

WILLOW CAT, CHANNEL CAT, WHITE FULTON (*Ictalurus punctatus*, Raf.)

Young 5 to 7 inches long were frequent in some of the sloughs and were quite abundant in Bear Creek. No large examples were seen in the sloughs, but specimens weighing from a half to three quarters of a pound were abundant in the river, as was seen by the numbers caught on trot lines. The young are called "fiddlers" by fishermen.

Localities: Bear Creek, Dead Man's Slough, Willow Slough, Long Lake, Broad Lake, Wood Slough.

FAMILY AMIIDÆ (DOG-FISH.)

DOG-FISH (*Amia calva,* Linn.)

Young dog-fish were not often seen in the pools outside the levee, but inside they were everywhere common. They measured from six to eight inches in length. In Bear Creek they were especially abundant, sometimes sporting at the surface in great numbers. Adults were also taken inside the levee. They certainly spawn on flooded bottom-lands in early spring; and I can account for their almost total absence from the temporary pools only by supposing that the young follow the adults into the deeper waters as the bottom-lands become exposed. Young a few inches in length are caught by the hundred at times for trot line bait, their desirable quality for this purpose being an extreme hardiness when on the hook.

Localities: Ballard Slough, Harkness Slough, Bear Creek, Goose Lake, Dead Man's Slough, Moss Lake, Willow Slough, Long Lake, Broad Lake.

FAMILY LEPIDOSTEIDÆ. (GARS.)

SHORT-NOSED GAR (*Lepidosteus platystomus*, Raf.)

Young examples from 8 to 12 inches long were very common in some of the lakes and sloughs, and were seen frequently lurking about barges and fish boats in the bay. No large examples were seen. They are quite sportive at times, and keep up a constant splashing of the water as a skiff moves among them. Hundreds were seen at the south end of Long Lake. They were lying just beneath the surface, fanning the water with the fins sufficiently to keep the body stationary, and when approached would suddenly lash the tail out of water and disappear. The young of this gar averaged considerably larger than those of the other species and were more uniform in size. Eighteen examples taken at random from different situations average 9.94 inches in length from tip of snout to tip of caudal fin. With two exceptions all those seen had lost the caudal filament, and also, to a great extent, the black blotches of the very young. Those which possessed the filament were two of the three smallest examples taken, and measured respectively 8 and 8.50 inches in length. The largest examples seen measured 12.50 inches. If these young are from the eggs spawned this season, and I believe they are, they indicate a more rapid growth, or an earlier spawning time for this species than for *L. osseus*.

Localities: Harkness Slough, Goose Lake, Dead Man's Slough, Claus Lake, Quincy Bay, mouth of Cedar Creek, Wood Slough.

LONG-NOSED GAR (*Lepidosteus osseus*, Linn.)

The young were more abundant and more generally distributed than those of the preceding species. Thirty-eight examples give an average length of 8.10 inches. The smallest seen measured 6 inches in length, and the largest 12.25 inches. This last was the only one taken that had lost the caudal filament. The more uniform occurrence of this gar in bottom-land pools of all sorts and its greater abundance there, in addition to the smaller average size of the young as compared with those of *L. platystomus*, suggest a later spawning time. If the short-nosed gar spawns earlier, its young have more time to escape from the temporary pools, and we should expect to find fewer of them present in August. The matter needs further attention, however, as a difference in the relative abundance of adults in the river at this point, or some unknown difference in spawning habit, may have to do with some of the differences we have noted.

Localities: Harkness Slough, Dead Man's Slough, Moss Lake, Claus Lake, Willow Slough, Lily Lake, Long Lake, Broad Lake, Wood Slough.

FAMIDY POLYODONTIDÆ. (SHOVEL-FISH.)

SHOVEL-FISH (*Polyodon spathula*, Walbaum.)

This fish evidently does not spawn on the overflowed bottom-land. A single example about 14 inches long from Wood Slough was the only one taken. The adults are common in the Mississippi River, where they were occasionally seen leaping above the water.

FAMILY PETROMYZONTIDÆ. (LAMPREYS.)

LAMPREY EEL (*Petromyzon castaneus*, Gir.)

A lamprey taken by the men from Wood Slough was probably of this species. It was not secured for examination.

INVERTEBRATES.

Small animals, such as insects, crustaceans, and mollusks, were not as abundant as they commonly prove to be in permanent bodies of water in other localities. The absence of vegetation and the abundance of their enemies, the fishes, doubtless both had to do with this. The condition of these pools, as we have seen, is not favorable to a growth of vegetation, and the season was exceptionally unpropitious with respect to this. Those small creatures which did occur in the pools were thus deprived of the protection which a rank growth of vegetation affords, and could not be expected to maintain themselves where every square yard of bottom must have been searched each day by hungry fishes. Notwithstanding this condition of things, certain species occurred in considerable numbers. Such as have the curious habit of remaining motionless in the presence of enemies and such as burrow readily in mud, were very common in some of the pools. Consequently, when it is said that invertebrate animals were not common in these waters, it is meant that, as compared with permanent lakes elsewhere, there was not here a great diversity of forms represented each by an abundance of individuals.

MOLLUSCA. (Shell Fish.)

The Mollusca were represented in the locality by both Gasteropoda and Lamellibranchiata.

The snails were nearly all of small size, none of those seen having shells over 1.25 inches in length. These creatures are well suited to a residence in these ponds. Some of them, at least, can breathe either in water or in air, and hence can travel to other pools if the water dries up. A part of them never need to do this, for when the pools dry up, either in winter or summer, they resort to the mud and rubbish of the exposed bottom, close up their shells, and remain inactive till the water comes again. They are ordinarily seen creeping about over the bottom, where they feed upon microscopic plants and animals or upon decaying organic matter in the form of a slimy coat on sticks and mud. If pressed with hunger, they have been known to resort to animal food, and in some instances devour their own kind. Some of them burrow into the mud at the bottom and become torpid in winter, but more active species may be seen moving over the bottom under the ice. The eggs are laid in spring, attached in masses to sticks and dead leaves. The young hatch in two or three weeks, according to temperature.

FAMILY LIMNÆIDÆ. (POND SNAILS.)

Physa ancillaria, Say.

(Say, Jour. Acad. Nat. Sci. Phil., v, 124, 1825.)

Common in Long Lake and in Willow Slough. The largest examples taken measure about .50 inch in length.

Physa heterostropha, Say.

(*Limnea heterostropha*, Say, Am. ed. Nich. Enc., pl. i, fig. 6, 1817, 1818, 1819 [as cited by Binney].)

This was probably the most common snail in the bottom-land pools. It is one of the thin-shelled species, with about four whorls, and differs from the preceding in having a longer and more tapering spire and a narrower aperture. Otherwise they are much alike. This is one of the most active and widely distributed of the species taken. It is said sometimes to attack and devour insects as large as itself. The eggs are deposited, according to Say, in the month of May, but probably at intervals during the summer also. Egg masses, which in all probability were from this snail, were quite frequently found attached to the outside of shells, where they had been left by other individuals. The shells were frequently clothed with growths of stalked infusorians.

Localities: Harkness Slough, Quincy Bay, Willow Slough, Cedar Creek, Wood Slough.

Helisoma trivolvis, Say.

(*Planorbis trivolvis*, Say, Am. ed. Nich. Enc., pl. ii, fig. 2, 1817, 1818, 1819.)

Common in many of the pools. Easily recognized by its depressed shell,—the whorls lying nearly in one plane so that they can be followed on two sides of the shell. Large examples taken, measure five eighths of an inch in diameter.

Localities: Harkness Slough, Willow Slough, Lily Lake, Long Lake, Wood Slough.

FAMILY VALVATIDÆ.

Valvata tricarinata, Say.

(*Cyclostoma tricarinata*, Say, Jour. Acad. Nat. Sci. Phil., i, 13, 1818.)

This small mollusk was common in many of the pools, but was not often brought out in the nets from pools in which it was very abundant. The shell is about .20 inch in diameter and may be recognized at once among our species by the strong ridges on the outside of the shell. It is somewhat depressed and the aperture is nearly circular in outline. The food is said to be vegetable matter. The eggs of related European species are deposited singly.

FAMILY VIVIPARIDÆ. (RIVER SNAILS.)

Vivipara intertexta, Say.

(*Paludina intertexta*, Say, New Harmony Disseminator, ii, 244, 1829.)

A common and uniformly distributed snail of rather large size. Shell rather stout, with about five strongly convex whorls. Adults dull reddish brown in color; young paler, with numerous fine revolving striæ on the whorls. The largest example taken measures one inch in length, with the largest whorl .87 inch in diameter. Inside the aperture may usually be seen several large reddish brown revolving bands. The young are born alive.

Localities: Harkness Slough, Willow Slough, Lily Lake, Long Lake, Wood Slough.

Vivipara subpurpurea, Say.

(*Paludina subpurpurea*, New Harmony Disseminator, ii, 245, 1829.)

Found only in Lily Lake. It is much like the preceding, but has a slightly more tapering shell with the whorls flattened next the revolving suture.

Campeloma decisum, Say.

(*Limnæa decisa*, Say, Am. ed. Nich. Enc. 1, 1817.)

This was the largest and most abundant river snail observed. It may be distinguished from the two preceding by its more slender form, more tapering spire, and less convex whorls. The general color is a uniform olive green, more or less stained towards the apex with brown. Inside the aperture pure bluish white. An example measures 1.37 inches in length, with the largest whorl .87 inch in diameter. The young are brought forth alive, and may be found in the ovaries in the fall preceding the spring during which they are set free. The adults go into the mud at the bottom of the ponds and streams to hibernate.

Localities: Harkness Slough, Quincy Bay, Willow Slough, Lily Lake, Broad Lake, Wood Slough.

Lioplax subcarinata, Say.

(*Limnæa subcarinata*, Say, Am. ed. Nich. Enc. 1, 1816.)

Frequent in Willow Slough. Similar to the preceding, but smaller and marked by an obtuse ridge extending along the middle of each whorl. One of the largest examples taken is just .50 inch in length. Like the other members of the family it is viviparous.

FAMILY RISSOIDÆ.

Somatogyrus isogonus, Say.

(*Melania isogona*, Say, New Harmony Disseminator, ii, 227, 1829.)

Numerous examples from Willow Slough, Aug. 15.

Amnicola limosa, Say.

(*Paludina limosa*, Say, Jour. Acad. Nat. Sci. Phil., i, 125, 1817.)

Dredged in 3–5 feet of water, Willow Slough, Aug. 15.

The clams are not very different from the river snails in their way of living. They may be frequently seen in shallow water with the front part of the body buried in the mud and the soft, white "foot" thrust out of the shell. If watched intently under such circumstances they may be observed to move slowly forward, leaving a groove in the mud behind them. In suitable places in quiet water they may become very abundant, forming what are known as clam beds. The food of some of our species consists entirely of microscopic plants and animals, such as algæ and protozoans. Some of the Unios are very probably scavengers, if we may decide from the condition of food in the stomachs of alcoholic specimens. In winter our species probably all go into the mud at the bottom of the streams and lakes, and there remain torpid until spring.

Their interest, viewed either from the standpoint of the fish-culturist or from that of the scientist, is very great. As

Prof. Forbes has shown in his papers on the food of fishes, they constitute a large item of the food of some of our best fishes. The great abundance in which they occur in the water of this region must give them a decided influence, as competitors for food.

Of the two families appearing in the Quincy collection, the first is represented by small species which commonly pass for the young of the true clams (Unionidæ) of the second family. That they are adult animals is, however, easily shown with a magnifying glass, since by its means they may be seen in many cases to contain living young of relatively large size. The shells of these bivalves are not commonly more than half an inch in length.

FAMILY CORBICULIDÆ.

Sphærium solidulum, Prime.

(*Cyclas solidula*, Prime, Proc. Bost. Soc. Nat. Hist., iv, 158, 1851.)

Common in shallow water in Willow Slough.

Sphærium transversum, Say.

(*Cyclas transversa*, Say, New Harmony Disseminator, ii, 346, 1829.)

Frequent in several of the pools.

Localities: Willow Slough, Long Lake, Broad Lake, Wood Slough.

FAMILY UNIONIDÆ. (RIVER CLAMS.)

Anodonta grandis, Say.

(Say, New Harmony Disseminator, i, 341, 1840.)

This large, smooth, thin-shelled clam is common in most of the sloughs and lakes. It is probably the species which the channel catfish manages to tear from its shell. The shells recently emptied were sometimes brought out by seines in great numbers. Young and adults were seen in the sloughs and lakes, one of the former measuring .62 inch in length. A valve of a large one, picked up at the edge of Wood Slough, measured 6.75 inches in length.

Localities: Lily Lake, Broad Lake, Wood Slough.

Anodonta imbecilis, Say.

(Say, New Harmony Disseminator, 1829.)

Young examples about an inch long were very common in Wood and Willow Sloughs. The adults were not seen.

Localities: Willow Slough, Lily Lake, Wood Slough.

Unio alatus, Say.

(Say, Nich. Enc., Am. ed., pl. iv, fig. 2, 1816, 1818, 1819.)

Taken in Willow Slough and Lily Lake.

Unio gracilis, Barnes.

(Barnes, Silliman's Jour., ii, 174, 1823.)

Taken in Willow Slough.

Unio lævissimus, Lea.

(Lea, Am. Phil. Soc., iii, pl. 13, fig. 23; Obs. on Genus Unio, I.)

This is one of the large compressed species with angular expansions of the dorsal or hinge portion of the shell. The young are especially noticeable because of the large relative size of these angular processes, and were very common in portions of Wood and Willow Sloughs. In Lily Lake, also, they were numerous, but were not seen elsewhere.

Unio parvus, Barnes.

(Barnes, Silliman's Jour., vi, 174, 1823.)

Examples of this small clam 1.62 inches long were taken in Harkness Slough. It was not observed outside the levee.

INSECTA.

Unfortunately, little has been done on aquatic insects by entomologists, beyond describing and naming the species, and a search through the writings of American and foreign authors does not yield much of the particular kind of knowledge of which practical fish work stands in need. The food habits and transformations especially have been greatly neglected. We cannot therefore give such an account of the species collected as could be wished, but shall aim to add something to a knowledge of food habits in certain cases, and to point out, as clearly as we can in a brief paper, the forms whose acquaintance the economic ichthyologist needs to make.

An exhaustive treatment of the group in its relations to fish culture would call for an account of every order of the class; for while such orders as Hymenoptera and Lepidoptera are very largely terrestrial, a glance at Prof. Forbes's most recent paper on the food of fishes will show that even bees, moths, and lepidopterous larvæ are devoured when chance brings them within reach. Freshets surprise and carry into the current of streams great numbers of terrestrial beetles and bugs which live in the earth, under dead leaves and on vegetation, and these furnish at such times no inconsiderable part of the food of the smaller fishes.

The common aquatic insects belong to the following orders: Diptera, Coleoptera, Trichoptera, Neuroptera, Hemiptera (true bugs), Ephemeridæ, Plecoptera, and Odonata. Some of these live in the water throughout life; others in the larval and pupal stages; still others in the larval and mature stages; while a part are aquatic only in the larval condition. The food varies greatly with the species and may vary with different stages of the same insect. It consists of decaying organic matter, or of living plants or animals, while some forms constantly take a mixed aliment. It is not possible therefore with our present knowledge of the subject to calculate the effect of a sudden removal of the whole group from its relations to the other life of our waters; but considered only as fish food there can be no doubt that the effect would be decidedly to the detriment of fishes. Even those insects that prey upon the eggs and young of fishes are themselves in turn devoured by the adult fishes, and there seem to be very few indeed of the aquatic insects that are not eaten by fishes in greater or smaller numbers.

ORDER DIPTERA. (FLIES.)

Flies of at least nine families are aquatic in the larval stage; but the majority of the individuals commonly collected in our waters pertain to the families, Simulidæ, Culicidæ, Chironomidæ, and Tabanidæ. To the first-named family belong the notorious black fly and buffalo gnat. The larva of a very similar species (perhaps the same as one or the other) is very common in winter and early spring under rocks and wood in spring-fed streams in Illinois, but the flies are not known to damage stock in this region (central Illinois). The larvæ of this family are eaten by trout, and occur in the stomachs of other smaller fishes. The pupæ live in leathery cases attached to the underside of stones and other objects in the water. The adult fly emerges under water in the spring of the year. Cedar Creek is exactly suited to these insects, and we should expect to find them there at the proper season.

The families Culicidæ and Chironomidæ contain the mosquitoes and gnats. The larvæ occur in water at all times of the year, so that in all probability a succession of broods are reared each season. Some species, at least, are found in water when cold weather comes in the fall, and doubtless remain in the larval condition till the next season. The eggs are placed in small masses on the surface of the water, where they float till the larvæ emerge. The food is believed, commonly, to be decaying organic matter, so that the larvæ have been thought to offset in a measure, as fish-food and as scavengers, the inflictions of the adults. They are extremely common, and may be captured at night in surface nets literally by the pint.

The family Tabanidæ (the horse flies) contains a number of species with aquatic larvæ. The eggs, which are elongated, smooth and shining, and of a dark color, are deposited in masses by the flies on rushes and other aquatic plants in the latter part of summer. The larvæ live during the winter in the water, lurking about under submerged wood or refuse. They are carnivorous, and with their strong mouth parts can inflict a severe bite. From their strength and activity they must destroy great numbers of the smaller aquatic animals. One kept by the late B. D. Walsh, fed upon a number of mollusks, pushing its way into the shells as far as it could, as it devoured the owners. Notwithstanding their aggressive ways, quantities of them are sometimes taken by the channel catfish (*Ictalurus punctatus*), and they are eaten, at least occasionally, by bull pout.

FAMILY CULICIDÆ. (GNATS AND MOSQUITOES.)

Culex sp.

The adults of one or more mosquitoes were moderately common about the sloughs. The larvæ were not observed except in one of the more stagnant bodies of water, but were probably present in all. These insects pass the winter in the winged state, hid away in crannies. The larvæ swim head downward, and are the "wigglers" of neglected cisterns and rain barrels. The food during aquatic life is probably decaying organic matter.

Corethra sp.

The larvæ of this genus are small, worm-like creatures, those from Quincy about .32 inch long and .028 inch in diameter. The body is cylindrical, tapering towards the posterior extremity. The head is provided with a perplexing variety of structures for the perception and management of food, including eyes, antennæ, biting jaws, and a number of other tactile and prehensile appendages. In front of the eyes the head resembles a truncated cone, and at the blunt front extremity is attached a pair of antennæ consisting each of a long basal segment, from the free extremity of which arise from three to five long, curved, and tapering rods. Near the posterior end of the body is a series of long, plumose filaments. The body is beautifully transparent in life, and within it may be seen, near each extremity, a pair of pigmented, kidney-shaped respiratory sacs.

The pupæ may be distinguished from those of the next genus by the presence on each side of the thorax of an odd, bladder-like respiratory structure, the two resembling a pair of ears. At the posterior end of the body is a pair of large fan-shaped fins, by means of which the pupæ swim freely in the water. The adults are small, weak, obscurely-colored gnats, which are not often observed. Two species of Corethra are recorded from this country.

Our larvæ resemble those of the European *Corethra plumicornis*, but differ apparently in some details of form,—as in the shape of the eyes, and of certain leaf-like tactile appendages in front of the mouth.

The eggs are laid enclosed in a gelatinous material, arranged spirally in a single series in disk-shaped masses, and float at the surface of the water till the young larvæ emerge. This occurs about a week after the eggs are laid, but probably the time varies greatly with the temperature.

FAMILY CHIRONOMIDÆ. (GNATS.)

The familiar aquatic larvæ of this family belong to the genus Chironomus. Probably no other one genus of insects constitutes as important an item in the food of as large a number of fishes. They may be recognized by their uniformly cylindrical bodies, small heads, enclosed in an opaque crust, and with a bilobed foot-like process bearing a dense brush of curved bristly hairs extending forward beneath it. At the posterior end of the body is a pair of false feet, also characteristic, each bearing a circlet of retractile hooks. The head is smaller relatively than that of the larva of Corethra, but under the microscope the parts appear almost as complicated. The structures present, however, are mainly in the nature of biting organs, the parts having to do with perception being here poorly developed. Thus the jaws are well developed, the edges of the mouth-opening are furnished with numerous teeth and hooks, and the labium is a broad plate with strongly toothed edge, while, on the other hand, the eyes and antennæ are very small. All this corresponds with what is known of the food of the larvæ. Their digestive tube is often filled with a brown granular material, consisting, as nearly as can be made out with the microscope, of decomposed organic matter containing great numbers of bacteria and a good many empty frustules of diatoms. In one example was found the fragments of an insect. The organs for mastication, complicated as they are, would hardly be equal to the complete obliteration of the cell-structure of plants and animals, were these the aliment upon which the larvæ depended, and I believe that the material in the alimentary canals examined was dead when taken. The diatoms were not more frequent than they would be if taken in the slimy coating which collects on submerged objects. The insect fragments, which were of rather large size, bore evidence of having formed a rejected skin; while the abundance of bacteria among the alimentary contents points also in the same direction.

The larvæ are often of a blood-red color. They swim by a wriggling movement when in open water, but commonly live at the bottom, under stones and rubbish, where they construct galleries of agglutinated sand in which numbers live together. They may be found in water at all seasons of the year, even under the ice in winter. Quite a number of species are represented by the larvæ taken at Quincy, and some of the forms described below may represent several related species instead of one.

The pupæ differ from those of Corethra in having cottony tufts or antler-shaped fleshy respiratory appendages on each side of the thorax; but some apparently lack these structures. Those with the cottony tufts were common in the galleries under rocks. The ones with antler-shaped respiratory structures were taken at the surface in the bay, and may prove to be free-swimming. Several of these latter had the posterior part of the body enclosed in the larval skin.

The winged adults were emerging at the surface of the bay August 8. Those captured, nearly all females, were brought in by the surface net, and are probably among the smallest of the genus, being only about .08 inch long. Color, pale yellow, with three large, brown, longitudinal spots on the thorax, the middle one placed before the others and continued behind by a very narrow median brown line. Segments of abdomen brown centrally above; pale at the margins and below. Antennæ, legs, and balancers, whitish. Wings unmarked. One male taken is more distinctly marked, and shows some dusky on the legs and ventral side of the thorax, while the plumose antennæ are decidedly blackish.

Chironomus, larva (1).

Large examples of this larva average about .44 inch in length. Head, yellowish brown. Eye-specks, two. Labium with strongly arched anterior edge, cut into about six black teeth on each side, with a median tricuspid tooth. Posterior segments with three pairs of fleshy (respiratory?) appendages; the first pair short and club-shaped, attached at the posterior edge of the antepenultimate segment, the second and third pairs long and contorted, attached the one to the middle and the other to the posterior edge of the penultimate segment. The four anal papillæ rather slender, enlarging a trifle distally.

Pupæ constantly found in sand galleries with this larva have a pair of strong frontal hooks and are provided with cottony respiratory tufts on the thorax. Length about .32 inch.

These larvæ and pupæ were taken in numbers under rocks, a short distance within the mouth of Cedar Creek. Young short-nosed gars (*L. platystomus*) had invaded the creek from the bay and were busily probing the crannies and feeding on the insects. One hundred and eighty-three larvæ and forty-two pupæ were counted in the stomach of a single gar about nine inches long.

Chironomus, larva (2).

About equal to (1) in size. Head pale brown, under side black. Two eye-specks. Labium with four teeth on each side; median tooth shorter than the two next it. Hairs of anterior pediform appendage rusty. A single pair of small club-shaped (respiratory?) appendages at posterior edge of the penultimate segment. Anal papillæ conspicuously enlarged distally. Less common than (1), but more widely distributed.

Localities: Willow Slough, Cedar Creek, Broad Lake, Wood Slough.

Chironomus, larva (3).

Small; the largest of two examples taken, only .24 inch long. A single eye-speck. Posterior segments without fleshy respiratory appendages. Anal papillæ apparently jointed.

One example each from Willow Slough and Cedar Creek.

Chironomus, larva (4).

A single very large larva, 1.38 inches long, from Ballard Slough, seems to differ from all the preceding. Head black beneath; eye-specks two. Labium with a large truncate median tooth, with a small tooth each side of it; outside the latter, two other large truncate teeth,—about four teeth, large and small, on each side. Posterior segments without fleshy respiratory appendages. Anal papillæ not jointed.

Chironomus, larva (5).

A very small pupa (.12 inch long) taken August 7 within the mouth of Cedar Creek still retained its larva skin, the labium of which differs from that of all the preceding larvæ in lacking the median tooth. Its condition would not permit of more extended comparison with the others, and it may prove the same as (3).

Ceratopogon, larva.

This is an extremely slender, transparent larva, resembling a vinegar eel, with eight long hairs radiating from the posterior body segment. It has been noted by Professor Forbes in the stomachs of fishes.

Common among algæ in Lily Lake August 15.

ORDER COLEOPTERA. (BEETLES.)

The aquatic members of this order of insects frequently have some or all of their limbs flattened and fringed to fit them for rapid locomotion in the water. Others show little in their structure that is adaptive to aquatic life, and simply creep about under water or cling to submerged vegetation much as a terrestrial beetle might. They are all, when adult, obliged to come to the surface for air, which they take and hold in bubbles by means of antennæ, wing-covers, or legs. Some of the larvæ also come to the surface for air, but others are provided with special respiratory structures by means of which they are enabled to get oxygen from water. Only the larvæ and adult beetles are aquatic. The larva quits the water when ready to become a pupa, and commonly burrows into the neighboring banks, where it excavates a small chamber in which it pupates. The adult on emerging returns at once to the water.

Many beetles in both larval and adult stages are very destructive to small aquatic animals of other kinds, and even attack fishes of considerable size. Tadpoles many times larger than these insects are often devoured. Some eat only the dead of other insects, while still others feed largely on vegetation.

The families containing aquatic species are Amphizoidæ, Haliplidæ, Dytiscidæ, Gyrinidæ, Hydrophilidæ, Parnidæ and Dascyllidæ. The great majority of individuals and species commonly taken in water pertain to the Haliplidæ, Dytiscidæ, Gyrinidæ, and Hydrophilidæ. Several other families may appropriately be considered in connection with aquatic insects because of their constant abundance in the moist earth along water and on sub-aquatic vegetation. These beetles are unquestionably an important source of food to the carnivorous aquatic animals, and themselves doubtless attack and devour their aquatic neighbors when chance brings these latter ashore.

FAMILY CARABIDÆ. (PREDACEOUS GROUND BEETLES.)

A few species of Bembidium and Elaphrus were generally to be found on sunny days at the edges of sloughs, running over the mud. Under the logs in the neighborhood were the usual carabids of such situations — Galerita, Chlænius, and Pterostichus — but they were by no means common. The seining operations sometimes revealed the presence of certain burrowing species, such as *Omophron americanum*, in the moist mud of the shores ; and in the latter part of August a sudden rise in the water surprised numerous examples of Clivina and Bembidium, which were noted floating on the surface at the mercy of predaceous aquatic animals.

FAMILY HALIPLIDÆ.

The larvæ of this family are odd-looking creatures with strong spines or long-jointed respiratory appendages on the segments, the 9th (last) segment being produced and divided. Tarsi with a single claw. The larvæ of our two genera may be recognized by the following characters :

Haliplus.—Spiracles present, no branchial filaments. Maxillary palpi three-jointed. Clypeus truncate.

Cnemidotus.—No spiracles, branchial filaments long and jointed. Maxillary palpi two-jointed. Clypeus notched.

Cnemidotus 12-punctatus, Say.

(*Haliplus 12-punctatus*, Say, Trans. Am. Philos. Soc., N. Ser., ii, 106, 1825.)

The beetles were moderately common in Willow Slough, where they were brought out by the dredge and dip net. Females taken August 15 contained ova with advanced embryos.

FAMILY DYTISCIDÆ. (PREDACEOUS WATER BEETLES.)

The larvæ of these beetles are known as water-tigers from their rapacious habits. They have smooth bodies and long sickle-shaped jaws. In addition to these characters may be mentioned, as distinguishing these larvæ, the laterally placed antennæ, the presence of two claws on the tarsus, and the apparent absence of the 9th segment of the abdomen.

Both adults and young lead a predatory life, attacking and devouring whatever they can master. They do not hesitate to attack animals many times larger than themselves and are very destructive in fish ponds to young fishes. They are in turn eaten by the larger fishes. They live, in some cases, several years. In the fall some of the beetles go into the mud to hibernate; others may be seen actively swimming about in mid-winter; and a few leave the water to hibernate under rubbish. The eggs are laid at intervals, and are scattered. Some, at least, of the larvæ become pupæ in the fall and emerge as adult beetles the following spring.

Laccophilus maculosus, Germ.

(Germar, Ins. Spec. Nov., p. 30 [as cited by G. R. Crotch]; Say, Compl. Writ., ii, 514.)

From Cedar Creek, Aug. 8. Apparently not common.

Laccophilus fasciatus, Aubé.

(Aubé, Species Général des Coléoptères, vi, 423, 1838; Crotch, Trans. Am. Ent. Soc. iv, 400, 1872–73.)

This small beetle, generally common in our ponds and lakes, was seen only in Cedar Creek.

Bidessus lacustris, Say.

(*Hydroporus lacustris*, Say, Trans. Am. Philos. Soc., N. Ser., ii, 103, 1825; Compl. Writ., ii, 517.)

A minute species taken in Willow Slough and Cedar Creek.

Hydroporus aulicus, Aubé.

(Aubé, Species Général des Coléoptères, vi, 572, 1838; Crotch, Trans. Am. Ent. Soc., iv, 396, 1872–73.)

Not rare in Wood Slough.

Hydroporus vittatipennis, G. & H.

(*H. lineatus*, LeConte, Proc. Acad. Nat. Sci. Phil., vii, 296, 1885.)

Common in Willow Slough.

Hydroporus consimilis, Lec.

(LeConte, Agassiz's "Lake Superior," 214, 1850.)

Very abundant in crannies of decaying and submerged wood in Willow Slough.

Hydroporus hybridus, Aubé.

(Aubé, Species Général des Hydrocanthares et Gyriniens, 573, 1838.)

Common in Long Lake Aug. 9. Also found in Broad Lake and Willow Slough.

Coptotomus interrogatus, Fabr.

(*Dytiscus interrogatus*, Fabr., Systema Eleutheratorum, i, 267, 1801; Crotch, Trans. Am. Ent. Soc., iv, 413, 1872-73.)

Very abundant in Willow Slough and common in Long Lake and Cedar Creek.

Acilius, larva.

This larva is a trifle more than an inch long (1.12 inches), with a fusiform body terminating behind in a pair of short naked caudal stylets. It agrees very closely with the account of a European species (*Acilius sulcatus*) given by Schiödte. The head is rather small, with two contiguous brownish black spots on the front, and a median spot of this color midway between these and the posterior margin. Sides of head dusky. Segments of thorax and abdomen pale olive above, the scutes of the abdominal segments narrowly edged with black, under parts and legs chiefly white. It differs from the European species in the form of the ligula, which is produced, and furnished at its tip with two strong setæ.

From Cedar Creek, Aug. 8.

Thermonectes basilaris, Harr.

(Harris, N. E. Farmer [as cited by Crotch]; Crotch, Trans. Am. Ent. Soc., iv, 402, 1872–73.)

About .44 inch long, general color black, with front, sides of thorax, and elytra yellowish brown. A line of this color also across the middle of the thorax. This was the largest beetle of its family taken at Quincy. It was captured in the same locality as the larva preceding, and may prove to be the adult, since the genera Acilius and Thermonectes are closely allied.

Locality, Cedar Creek.

FAMILY GYRINIDÆ. (WHIRLIGIG BEETLES.)

These are the shining black beetles so often seen in large numbers circling about on the surface of the water. The three American genera all have representatives in Illinois. They secrete a milky fluid which probably is offensive to fishes, since notwithstanding the great numbers in which they occur, they are very rarely eaten by other animals. The eggs are placed in parallel rows on the leaves of plants in the water. The larvæ of European species are fully grown at the beginning of August, and creep up rushes and spin upon these a papery cocoon. The adult beetle emerges from this in about a month and returns to the water, where it hibernates in the mud. In some cases the cocoon is placed at some distance from the water, under the bark of trees. The beetles are said to feed on dead insects. The larvæ may be known by their long slender bodies, the nine abdominal segments of which are furnished at each side with long fringed respiratory appendages. Tarsi with two claws. Posterior end of body with four curved hooks.

Gyrinus analis, Say.

(Say, Trans. Am. Philos. Soc., ii, 108, 1825 ; Compl. Writ., ii, 520, 562.)

A small Gyrinus, which I presume to be this species, was seen frequently on the pools in immense swarms, often with a few specimens of the larger Dineutes among them. When they were dipped up and carried ashore they turned and began making their way back to the water with surprising unanimity. This evident knowledge of their whereabouts and ability to take care of themselves on land was quite in contrast with the behavior, under similar circumstances, of the equally common water bugs of the genus Corisa. The latter, when brought ashore by the nets, scattered in every direction, and few of them ultimately reached the water again. The food of those examined consisted entirely of fragments of insects, which, judging by the large number of hairs, scales, and fragments of legs, were from moths which had fallen upon the water. Other species of Gyrinus from other parts of the State have been found to contain similar matter, from which it seems probable that they depend upon food of this character.

Dineutes assimilis, Aubé.

(*Cyclinus assimilis*, Kirby, Fauna Bor. Am., iv, 78, 1837; *Dineutes assimilis*, Lec., Proc. Acad. Nat. Sci. Phil., xx, 366, 1868.)

Two of three specimens examined contained fragments and scales of moths; and the third had eaten fragments of small predaceous land beetles and an aquatic worm,—Lumbriculus, or of some allied genus. The beetles are the common large whirligig beetles of ponds and lakes everywhere in the State. They were common in most of the pools at Quincy, and a few were noted sheltered among the branches of a partly submerged tree that had fallen into the swift current of the Mississippi River.

Gyrinus, larva.

A small larva about .25 inch long, from Wood Slough, agrees exactly with published accounts of larvæ of this genus. Only one example was taken, though doubtless they were common, judging by the abundance of adult beetles.

FAMILY HYDROPHILIDÆ.

In the beetle state the food of this family is largely decomposing vegetable matter. Occasionally the large species attack mollusks or amphibians. The larvæ are carnivorous, and, like those of the Dytiscidæ, do a good deal of damage in fish ponds. They have a single tarsal claw. The labrum is wanting. The 8th pair of spiracles is terminal, and the posterior end of the body is devoid of hooks. Some have fringed appendages along the abdomen like those of Gyrinus larvæ.

The eggs are placed by the female in a silken case, sometimes attached to leaves or sticks which keep it at the surface, in other cases carried about by the beetle. A single case may enclose a hundred or more eggs. After hatching, the young larvæ remain for some time in the case, where they are protected from their enemies and insured a supply of air by being kept at the surface. A European species, very similar to our large black Hydrophilus, becomes fully grown as a larva in one hundred days, and leaves the water to burrow in the earth for pupation. The beetles hibernate in the mud and under rubbish.

Hydrochus squamiger, Lec.

(LeConte, Proc. Acad. Nat. Sci. Phil., vii, 359, 1855.)

Found in Willow Slough August 15. Not common.

Hydrophilus nimbatus, Say.

(Say, Jour. Acad. Nat. Sci. Phil., 203, 1823; Compl. Writ., ii, 130.)

This species is evidently a scavenger. The digestive tube is long and coiled like that of a tadpole. It is commonly filled with a brown matter, largely granular and unrecognizable, among which are numerous diatoms, desmids, and fragments of filamentous algæ.

Moderately common in Willow Slough and Cedar Creek.

Berosus pantherinus, Lec.

(LeConte, Proc. Acad. Nat. Sci. Phil., vii, 364, 1855; Horn, Proc. Am. Philos. Soc., 1873, 122.)

A common and widely distributed species. The long intestine is filled with matter like that found in *Hydrophilus nimbatus*,—probably largely decaying vegetable matter. Mixed with the granular matter are many diatoms and bits of filamentous algæ.

Localities: Harkness Slough, Willow Slough, Cedar Creek, Long Lake, Wood Slough.

Berosus striatus, Say.

(*Hydrophilus striatus*, Say, Jour. Acad. Nat. Sci. Phil., N. Ser., v, 188, 1825; Compl. Writ., ii, 292.)

Food like that of the preceding species, the only recognizable objects in the alimentary canals being in this case diatoms.

The species is abundant in Cedar Creek, and was found also in Ballard Slough.

Hydrophilidæ, larva (1).

A small larva with depressed and rather stout body, with a median brown band on the head and a pair of obscure dusky longitudinal stripes on the abdomen above. Pale below. Sides of thorax and abdomen tuberculate. The mandibles are unlike any others we have seen. They are rather long, sickle-shaped, and bear at about the middle of their inner edge a strong tooth with bicuspid apex, minute denticles on its anterior edge, and one or two small teeth at its base. The largest example taken is a trifle more than a half inch long.

Locality, Cedar Creek.

Hydrophilidæ, larva (2).

A small larva about .25 inch long, common in Cedar Creek, is evidently the young of one of the above species of Berosus. The body is widest at the middle and tapers pretty uniformly to the extremities. Head small; ocelli superior; clypeus denticulate. Basal segment of maxillæ unusually long and strong. Segments of body coarsely wrinkled, the seven anterior divisions of the abdomen, each with a pair of long, naked respiratory filaments. Terminal segment nipple-shaped; no caudal appendages. Young examples are transparent in life, but grow more opaque when older.

Family Staphylinidæ. (Rove Beetles.)

Small species of this family of beetles were always common in the mud and sand at the edges of sloughs, and many were noticed floating and struggling on the surface in the latter part of August, after the water had risen suddenly.

Family Parnidæ.

These small beetles creep about or burrow in the mud under water. From the structure of the jaws they have been supposed to be carnivorous. The larvæ are greatly flattened and live under rocks, sometimes in rapid currents.

Stenelmis vittipennis, Zimm.

(Trans. Am. Ent. Soc., ii, 259, 1869; Horn, ibid, iii, 40, 1870–71.)

Taken in Willow and Wood Sloughs.

Macronychus glabratus, Say.

(Say, Jour. Acad. Nat. Sci. Phil., N. Ser., v, 187, 1827; Compl. Writ., ii, 292.)

Wood Slough, Aug. 4. Not common.

FAMILY HETEROCERIDÆ.

Heterocerus undatus, Mels.

This is a small brown pubescent beetle about .20 inch long, with a few irregular yellow marks on the wing covers.

It occurred in very great numbers in the earth at the edges of the more isolated sloughs, in burrows resembling miniature mole hills. When the seines brought the water over the burrows the beetles at once appeared and took flight. The larvæ also were present in abundance, and were found at times exposed on the surface of the water.

My attention was especially drawn to the curious little mud cases which the larvæ construct when ready to pupate, and of which I have seen no published description. The cases are always made in the moist mud at the immediate edge of the water and are carefully detached from the adjacent soil, so that each stands in a little hollow. From one side arises a closed chimney often equal in height to the basal portion of the case. The beetles were emerging from the cases on the 11th of August, always making their way out by creeping up the chimney and breaking through its extremity. The beetles were seen along most of the sloughs and lakes. The mud cases were noted as especially abundant along Long and Broad Lakes and Harkness Slough. At the edge of the first-named lake eighteen of the cases were counted on an area about one foot square. The food of both adults and larvæ consists of brown granular matter containing numerous diatoms, and of small cells, isolated and in chaplets, of what Prof. Burrill thinks is a Conferva,—one of the algæ which grow on moist surfaces.

ORDER TRICHOPTERA. (Case Flies.)

Larvæ of this group usually construct movable or fixed cases with openings at the ends. These cases are sometimes of peculiar shape, and oftener attract attention than the winged insects. They may be cylindrical, cone-shaped, spiral, like a flattened ink bottle, etc., and generally have bits of vegetation, or sand, fastened over the outer surface. The adults are small obscurely-colored insects, which usually take no food, and after depositing their eggs soon die. The eggs, enclosed in a gelatinous material, are placed on aquatic plants, the females, it is thought, sometimes descending into the water for this purpose. The larvæ feed on vegetable matter, such as dead leaves, stems, and wood, but sometimes devour also small insects and crustaceans. Those I have examined are abundant in small streams in central Illinois, and make large cylindrical cases, to the outside of which are fastened, longitudinally, numerous small sticks. The alimentary canal of this larva has always been found filled with decayed woody vegetable matter. The pupæ are formed in the cases, which are, if movable, fastened down by the larva previous to pupation.

Trichoptera, larva (1).

The common case-fly larva at Quincy was a somewhat unusual one as to habits. Most of our species creep slowly about on vegetation or on the bottom. This one is a free-swimming larva, and one or two were always taken when the surface net was drawn over the deepest water of Quincy Bay. It was captured on one occasion in the swift current of the river in a net drawn after the steamer "Hannibal Eagle." The case is trumpet-shaped, gradually decreasing in caliber from the larger end (which has a diameter of about .07 inch) to the smaller extremity, where the diameter is about .03 inch. The outside of the case has scattered bits of dead vegetable matter fastened over it, and numerous minute particles of sand. Fastened to one side, sometimes to two sides, is a long rootlet or twig of a weed that may project at one or both extremities some distance beyond the case. The larva is plain white, with the head mottled with yellow and deep brown. Along the sides are attached fleshy respiratory filaments. The usual tubercles and hooks for adhering to the case are present. It swims by striking the water with the very long and heavily fringed hind legs, these being projected beyond the large opening for this purpose.

Trichoptera, larva (2).

A second larva lives in a short, conical case about .25 inch long, with a diameter of .125 inch at the larger and of .06 inch at the smaller end. The outer surface is thickly covered with bits of dead vegetation, but lacks the long pieces which seem never to be absent from the other cases. The larva also is short and stout, but is not otherwise very different from (1). The posterior legs are not so long and slender relatively and the fringe is less perfect. This form was taken from the bottom in Willow Slough.

Trichoptera, pupa.

A pupa of some species of this group was taken in Willow Slough sealed up in its cylindrical case of dead vegetable materials. At the end towards which the head lay, a narrow slit had been left for the passage of water for respiration. Judging by the cast larval skin with this pupa, it cannot belong to either of the two larvæ described.

ORDER NEUROPTERA. (HELLGRAMMITES AND LACE-WING FLIES.)

This order contains two families, the larvæ of which are very different in habit. The lace-wing flies are throughout life terrestrial, and are well known to gardeners and fruit-growers for the good they do by devouring plant-lice. The hellgrammites or crawlers are aquatic during the larva stage and feed upon other water insects, such as case-fly and May-fly larvæ. They are themselves, to some extent, used by sportsmen as bait in catching fishes, their tough skin rendering them easily disposed and retained on the hook. They are furnished with seven or eight pairs of respiratory filaments along the sides of the body for use in the water, and have, besides, breathing pores (spiracles), which they use when they leave the water to pupate in the earth. The tarsi have two claws. The eggs are deposited in large, whitish discoidal masses on the leaves of trees and on the sides of boats and barges.

Corydalis cornutus, Linn. (Hellgrammite.)

(Walsh and Riley, Am. Ent., i, 61, 1868.)

The larvæ and adult of this large insect often attract the attention of those who live on our rivers. The species is not often seen in the interior of the State. Along the Mississippi River it is very common, though its abundance is not commonly apparent excepting during the egg-laying season. In August the wood barges and boats in the bay were resorted to by the females, and the masses of eggs were left in numbers upon the timbers.

ORDER HEMIPTERA. (True Bugs.)

This is one of the most important groups of aquatic insects, both on account of the food its members furnish to fishes, and also because of the serious injuries which some bugs do to fish eggs and fry. The genera Ranatra and Belostoma are especially to be remembered as containing some of the worst insect enemies to fishes of which we know. Most of them begin a predatory life as soon as hatched from the egg, and continue it without cessation throughout their existence. The common food consists of larvæ of other insects, mollusks, and the like. The eggs are generally deposited on aquatic plants, sometimes enclosed in gelatinous matter, but in many cases quite naked. Corisa sometimes places its eggs on the shells of crayfishes. Eight families of the order have common representatives inthe waters of the State. Of these, five appear in the collection made at Quincy.

Family Hydrobatidæ. (Crazy Bugs.)

Limnotrechus marginatus, Say.

(*Gerris marginatus*, Say, Heteropterous Hemiptera, 1831, 807.)

The eggs of this "skipper" are attached to aquatic plants, and the young pupæ resemble the grown insect except for the wings and increased size. In winter the adults are found under rubbish in the shallow water at the edges of streams. The species was common in a number of the sloughs, and was noted especially in Harkness Slough, Willow Slough, and Long Lake.

Stephania picta, H. Sch.

(Uhler, Stand. Nat. Hist., ii, 270.)

A small brightly colored insect taken only in Wood Slough and Long Lake.

FAMILY VELIIDÆ.

Mesovelia bisignata, Uhler.

(Uhler, Stand. Nat. Hist., ii, 274.)

A small greenish yellow insect about .12 inch long, which is frequently found on the surface of water. Frequent at edges of Willow Slough August 15.

FAMILY BELOSTOMATIDÆ.

Benacus griseus, Say.

This is one of the large, flat, predaceous bugs that sometimes become destructive to young fishes. It is reported by Mr. C. A. Hart, of this Laboratory, as common at the electric lights in Quincy. It was not seen in the water, but this was doubtless due to some peculiarity in its habits. For some reason it is never brought out in the seines and dredges in parts of the State in which the numbers taken at electric lights show it to be very common. Our small species of this family (*Zaitha fluminea*) often comes out in the seines by dozens.

FAMILY NEPIDÆ. (WATER SCORPIONS.)

Ranatra 4-dentata, Stål.

(Stål, Öfv. af kongl. Vetensk.-Akad. Förhandl., 1861, 204; Uhler, Stand. Nat. Hist., ii, 255.)

This bug is very slow of motion and creeps about on the bottom or on plants, depending on its resemblance to a piece of dead vegetation for securing the animals upon which it preys, and for avoiding its enemies. It is said to puncture and destroy the eggs of fishes. Its own eggs are elongated and are provided with two long filaments at one end.

FAMILY NOTONECTIDÆ. (WATER BOATMEN.)

Notonecta undulata, Say.

(Say, Heteropterous Hemiptera, 1831, 39 ; Compl. Writ., i, 368.)

An active, predaceous insect, capable of inflicting a severe sting with its beak when handled incautiously. The eggs, which are elongated, cylindrical, and white, are attached to aquatic plants. The young have been observed to emerge in May.

Taken in Quincy on Cedar Creek.

Plea striola, Fieber.

(Uhler, Stand. Nat. Hist., ii, 253.)

A minute, brown, hard-bodied species, which is quite common in many streams in Illinois.

Taken only in Willow Slough. Not common.

FAMILY CORISIDÆ.

Corisa signata, Fieber.

(Fieber, Abhandl. Kön. Böhm. Gesell. Wiss., 1852, 233.)

This small species was extremely abundant in the temporary pools, especially so in Wood Slough.

Corisa alternata, Say.

(Say, Jour. Acad. Nat. Sci. Phil., N. Ser., iv, 329, 1825; Compl. Writ., ii, 251.)

This is the commonest Illinois Corisa. It was less abundant in some of the Quincy pools than the preceding, but was more widely distributed. Noted especially in Cedar Creek and Long Lake. The eggs are oval and have a small prominence at the free extremity. They are attached generally to plants.

ORDER ORTHOPTERA. (CRICKETS AND GRASSHOPPERS.)

This is a strictly terrestrial group, and calls for mention here only because of the constant presence, on the banks of streams and pools, of species belonging to it, which doubtless have an effect as fish food, and otherwise on aquatic life. At Quincy, a small cricket (*Tridactylus apicalis*) occurred in myriads among weeds which were springing up from the mud at the edges of sloughs, and individuals were sometimes found upon the water.

ORDER PLECOPTERA.

Small insects, which, as nymphs, live under rocks and boards, often in swift-flowing water. The pupa takes food, and after attaining its growth leaves the water, and transforms to the winged adult. In a number of points they are allied to the grasshoppers.

Plecoptera, nymph.

A flat nymph found in Willow Slough. It is about .52 inch long and bears at the end of the abdomen two long, jointed appendages. The antennæ are long and slender, the mouth parts much like those of a grasshopper or cockroach. Head very wide, and with a pair of compound and three simple eyes. Three divisions of the thorax large, with expanded terga, and bearing at each side cottony respiratory tufts. Legs with strong femora and three-jointed tarsi.

They were not common at Quincy, probably because the waters do not furnish them suitable shelter.

ORDER ODONATA. (Dragon Flies, Snake Feeders.)

These are predaceous when adult, feeding upon gnats, mosquitoes, flies, etc., which they capture while flitting rapidly about. Dragon fly larvæ and pupæ have the reputation of preying upon other insects, and as a rule this will probably be found true; but an examination of several larvæ shows them to be in some cases largely vegetable feeders and possibly scavengers, the alimentary canal containing numbers of desmids, diatoms, fragments of moulds, and a good deal of material (probably slime) gathered from the bottom for the small organisms and the organic matter contained in it. The eggs are dropped into the water as the females fly over it, or may be attached to submerged plants. Members of one genus are said to go beneath the surface and insert the eggs in the stems of plants. The young are common objects in the stomachs of fishes. The adults were not common about the pools in which the Fish Commission work was done. An occasional large species with clear wings was seen, and a small, slender-bodied form was noted as common about Lily, Long, and Broad Lakes. These were the only winged dragon flies seen. In the water, on the contrary, the immature stages of a number of species were common. These latter fall into four groups, which, for the purposes of this paper may be chacterized as follows :

Antennæ filiform, of seven articles. Legs slender, not suited to digging. Abdomen long, cylindrical, terminating in three large, flat, leaf-shaped respiratory appendages. Includes numbers 2 and 3........................Agrionina.

Antennæ stout, of four articles, the distal one rudimentary. Legs stout, suited to digging; tarsi of two anterior legs of two articles; tarsi of posterior legs of three articles. Labium not cleft. Includes numbers 4, 5, and 6..............Gomphina.

Antennæ filiform, of six or seven articles. Legs slender; all the tarsi of three articles. Labium with a narrow median cleft. Labial palpi not expanded and spoon-shaped. Includes only numbers 7 and 8.........................Æschnina.

Antennæ filiform, of seven articles. Legs slender. Labium not cleft. Labial palpi expanded and spoon-shaped, meeting along the middle line. Includes number 9–12....Libellulina.

1. *Agrion ramburii*, Selys.

(Hagen, Syn. Neur. N. A., 1861, 76.)

A small dragon fly with narrow transparent wings and slender body, with several of the hind divisions of the abdomen blue. Possibly the adult of one of the two following.

Common on the vegetation about Lily, Long, and Broad Lakes.

2. *Agrionina*, nymph.

A larva about .72 inch long; common in Long Lake. Chiefly brownish black. A pale, transverse band between the eyes, and a ring of minute, pale dashes at the hind margin of each abdominal segment. Legs chiefly white, a dusky band near the tip of each femur. Caudal respiratory appendages marked with broad, dusky cross bands; with a small spine at the apex of each, and with basal portion of edges spinose.

3. *Agrionina*, nymph.

A short larva, less than .25 inch long, with banded legs and antennæ, and a median dorsal pale line extending from head to end of abdomen. Possibly the young of the preceding, but I think not.

From Wood Slough, August 6.

4. *Gomphus*, nymph.

The larger examples of these young from Quincy are 1.10 inches long. The abdomen is greatly depressed, but is quite uniformly, though slightly, convex above. Palpus of labium with inner edge toothed to the base, distal tooth not longer than the others. Front edge of labium without median tooth. The wing-pads do not quite reach the hind margin of the second abdominal segment. This agrees with Dr. Hagen's No. 12 in his "Monograph of the Early Stages of Odonata." Common.

Localities: Quincy Bay, Willow Slough, Lily Lake, Broad Lake, Long Lake.

5. *Gomphus pallidus*, Ramb., nymph.

Dr. Hagen gives as the important characters of the young of this species, the presence of a median tooth on the front edge of the labium, the presence of teeth along the whole inner edge of the labial palpus, a median dorsal spine on the hind edge of the 9th abdominal segment, and the presence of lateral spines on abdominal segments 7–9. It may be distinguished from the two species here noted by the presence along the middle of the abdomen, above, of an obtuse ridge. Very common in some of the sloughs, and of large size, several measuring 1.20 inches in length. All those taken in August were apparently about ready to yield the winged form. Young of this species were taken in Cedar Lake in October, 1882. From the two observations it seems probable that the adults emerge in the latter part of summer, and that the young hatching from their eggs hibernate in the mud.

From Harkness and Ballard Sloughs.

6. *Gomphus notatus*, Ramb., nymph.

These young are like the two preceding in general appearance, but lack the median tooth of the labium of number 4 and the dorsal ridge of number 5. They differ from both of the preceding in having only about three blunt teeth on the inner edge of the labial palpi. The commonest Gomphus at Quincy. Of various sizes, some apparently ready to yield adults.

This is the *Gomphus fluvialis* of Mr. Walsh. Of the adult dragon fly, Mr. W. says that it flies constantly over water, and he thinks feeds exclusively on aquatic insects. It does not, as he supposed, breed exclusively in running water. Common.

Localities : Willow Slough, Lily Lake, Broad Lake, Wood Slough.

7. *Anax junius*, Drury.

The adult is one of our largest and commonest dragon flies. Its general color is obscure green, with some blue and black markings. Wings clear, with a yellow wash. The young are to be distinguished from all others taken at Quincy by the characters given at the beginning of this group. The very young are marked with wide transverse alternating bands of black and white.

Taken only in Long Lake, although the adults were seen now and then about several of the sloughs.

8. *Epiæschna heros*, (Fabr.) Hagen.

Two small nymphs, the largest one about .72 inch long, were taken in Wood Slough August 6. They were found clinging to dead sticks, depending apparently on their dark, obscure colors for immunity from enemies. They agree in the main with Mr. Cabot's description of the young of this species. The antennæ are of six articles, the distal one being longest. The labium is cleft, but lacks the tooth at each side. There are lateral spines on the abdominal segments 5–9, and most of the segments have a median dorsal ridge terminating in a tooth behind.

9. *Libellulina*, nymph.

A stout-bodied, pale brown nymph with scattered specks and spots of brown. Legs annulate with brown. Segments 8 and 9 of the abdomen with large lateral spines; no dorsal hooks or tubercles. The digestive tubes of several examples contained a good many microscopic plants and animals, together with a brown granular matter which I think had been gathered from the bottom. Extremely common in the upper part of Cedar Creek ; the only young of this group taken there.

10. *Libellulina*, nymph.

With a general resemblance to number 9, but rougher and the markings very obscure. A pair of tubercles between the eyes. A series of erect cultriform hooks on the middle of the abdomen, above. From the alimentary canal of one specimen a small mite was taken. Others examined did not contain food. Common and widely distributed.

Localities : Harkness Slough, Ballard Slough, Willow Slough, Lily Lake, Long Lake, Broad Lake.

11. *Libellulina*, nymph.

Much like 10, but with smoother body, and lacks the cephalic tubercles. A distinct dusky bar between the eyes. Legs annulate with dusky. Dorsal spines not cultriform, and not elevated behind. Not as common as the two preceding.

Localities: Lily Lake, Long Lake.

12. *Libellulina*, nymph.

Similar to number 10, and possibly the young of the same species. Tubercles of head relatively much larger. Dorsal spines tuberculiform, erect. Body more slender, nearly uniform blackish brown.

Two small examples from Willow Slough.

ORDER EPHEMERIDÆ. (MAY FLIES.)

The adults of certain species of this group are familiar to any one who has visited our rivers in July. They blacken the willows at the water's edge and cause the limbs to droop, in such quantities do they collect upon them. In the evening, at times, they mount into the air, and may be seen in countless numbers moving for hours in one direction as if bent on migration. They are excellent food for fishes, as is attested by the avidity with which many of our fishes eat them, and were used as bait by sportsmen in the days of Isaac Walton. The winged insect takes no food, and lives only for procreation, but may, in confinement, live a week or more. The eggs are dropped into the water or are placed upon plants, the flies descending into the water for this purpose. The larvæ (nymphs) devour earth and sand containing dead and living animal and vegetable matter.

Hexagenia bilineata, Say.

This is the common brown May fly of Illinois rivers and lakes. It occurs throughout the length of the State, and often in such multitudes as to have acquired the name "mormon fly." It is commonly very abundant in the middle of July. In August, at Quincy, it was rare.

Hexagenia, nymph.

An elongated, whitish creature, to be distinguished from most other aquatic insects by the presence of seven pairs of branchiæ, six of them plumose, attached along the sides of the abdomen and carried turned over the back. Jaws long and curved; front with an obtuse tubercle. Compound eyes, round, black; legs strong, suited to digging; abdomen terminating in three plumose stylets. Length of largest example taken at Quincy 1.20 inches. The food consists of earth richly charged with dead organic matter and with unicellular plants and animals. Such protozoans as Euglena are quite common in it. A large part of the contents of the digestive tube is sand, which seems to be taken incidentally. This is, in all probability, the young of *H. bilineata*.

It was common in Broad Lake; but elsewhere it was not often taken.

Localities: Willow Slough, Lily Lake, Long Lake, Broad Lake, Wood Slough.

Cœnis, nymph (1).

A small brown form with three long, fringed caudal appendages, and with the respiratory appendages on segments 1–5 of the abdomen; those on segments 3–5 concealed by the plate-like pair of the second abdominal segment. First respiratory appendages small, erect, not concealed. Head without conical tubercles. Antennæ, legs, and caudal appendages white, with brown annuli.

A few examples were taken in Willow and Wood Sloughs.

Cœnis, nymph (2).

A second small nymph, from Willow Slough, has three prominent conical tubercles on the head which agree very closely with those of the European species *C. luctuosa*, as figured in Mr. Eaton's monograph of this group of insects. Our insect differs in having the prothorax narrowed towards the front; and in certain other characters does not quite agree with Mr. Eaton's description of the genus.

ARACHNIDA. (Spiders and Mites.)

Tetragnatha grallator, Hentz.

(Hentz, Bost. Jour. Nat. Hist., vi, 26, Pl. iv, figs. 1 and 2.)

A small, slender-bodied, long-legged spider, large examples of which are .50 inch in length. Extremely common about the sloughs and lakes, often living over the water, exposed on dead stems and branches. It was sometimes brought in by the small seines in situations such that it seemed it must have been in the water. Its food probably consists of small gnats.

Arrenurus sp.

A pale water mite with long ciliated legs was frequently taken by surface nets in the deep water of the bay. It is, I believe, a river species.

VERMES. (Worms.)

This group is not of the same importance to fish culture as are the crustaceans and insects—unless it be as parasites—and we shall not give those observed at Quincy more than a passing notice.

One of the most interesting of those noticed is a small cylindrical worm with a retractile caudal disc from which arise four ciliated tentacles. It lives in great numbers in tubes on the under side of lily pads in Lily Lake, and when undisturbed lies with the hind end of the body out of the tube and, with the disc and tentacles expanded, sways slowly about. It will probably prove to be *Dero intermedius*, Cragin, though it is questionable if this is more than a variety of *D. digitata*, Mull.

Leeches which I have provisionally separated as five species were taken from the sloughs. All appear to belong to the genus Clepsine. Several of them were very common, being brought in on the shells of turtles, and at other times apparently attached to fishes.

Quite a variety of rotifers were observed, but none of special interest except the large and beautiful *Conochilus volvox*, colonies of which, consisting of a dozen or more individuals, were common in the open water of the bay, where they could always be taken in surface nets drawn after a skiff.

Plumatella arethusa, Hyatt.

(Hyatt, Observations on Polyzoa, 95.)

One of the branching polyzoans was very common in most of the pools, sometimes on sticks, on the under side of stones, and, in Lily Lake, on the under side of the lily pads. The statoblasts were frequently noticed scattered among algæ and rubbish.

Hyalinella vesicularis, Leidy.

(*Plumatella vesicularis*, Leidy, Proc. Acad. Nat. Sci. Phil., vii, 192.)

A single example of a small colony from Libby Lake, is referred to this species with some doubt.

Pectinatella magnifica, Leidy.

(*Cristatella magnifica*, Leidy, Proc. Acad. Nat. Sci. Phil., v, 265.)

The large masses of gelatinous matter so common in "back water" in this region, are formed by the colonies of this polyzoan. The animals themselves are on the outside of the masses and constitute but a small part of the bulk of each mass. In the upper part of the bay, in the inlets and mouths of sloughs, this animal was very abundant. As the water subsided the masses were often exposed, and were left in numbers to decompose in the air. One of the largest masses seen measured 16.50 inches in greater diameter by 12.50 inches in lesser diameter, with an average depth of about six inches. Small spindle-shaped colonies were common on the stems of dead weeds along the margins of the lakes. The shape of the colony seems to depend entirely on the character ofthe object upon which it is established. I could not see that fishes, or indeed anything else, fed upon the gelatinous material. Reproduction both by statoblasts and by eggs was in progress in August.

CŒLENTERATA.

Hydra fusca, Trembley.

These small animals are the closest allies of the corals and sea anemones of salt water, which our streams and lakes furnish. They are, when extended, about .25 inch long, and consist of a tubular body with a circle of tentacles about the one opening, the mouth. They are commonly found attached by the end opposite the mouth to plants and other submerged objects. I was surprised to find them on one occasion in Wood Slough in considerable numbers, and took others with the surface net in the bay, where they must have been floating at the surface. Those taken in Wood Slough, Aug. 4, were multiplying very rapidly by budding. The food consists of small animals which are captured by the tentacles.

PROTOZOA.

Notwithstanding their minuteness, the protozoa are of considerable importance as fish food, and are probably still more useful indirectly, since they constitute a large share of the food of insects.

At Quincy the animals of this group varied with the vegetation in the water. Where the plants were common, a variety of species and an abundance of individuals might be expected. In the river they were very rare. In the deeper water of the bay they were not as common as at its edges, among the wood rafts and the barges. They were most common in the stagnant water of the lakes. Such genera as Amœba, Difflugia, Centropyxis, Actinosphærium, Vorticella, and Euglena were abundantly represented. In Lily Lake a species of Pyxicola attracted attention from its abundance. It was noticed in the alimentary canal of the singular Dero mentioned above.

Two protozoans are especially deserving of mention here. The elongated green *Euglena viridis* was always to be found in water dipped up at any place in the bay. When the wind blew toward the west shore for a number of hours together a dense coherent green scum was observed to collect in the inlets and mouths of sloughs, and under the microscope this was found to consist largely of the contracted, spherical Euglenæ. When placed under the cover glass of the slide they soon become active again. Fishes and other animals could, and probably do, at such times collect them in quantities for food. The second protozoan is *Arcella discoides*, which occurred in numbers with the Euglenæ.

ARTICLE X.—*Notes on Illinois Reptiles and Amphibians, including several Species not before recorded from the Northern States.* BY H. GARMAN.

Emys meleagris, Shaw.

This fine turtle was as late as 1870 rather common about water on the prairies of central Illinois. It is now very rare, only one example having been taken by me in the past six years.

Chrysemys belli, Gray.

Very common in the sloughs of the bottom-land at Quincy. It has not been taken elsewhere in the State. Closely related to *C. marginata*, but I have not seen in many hundred painted turtles examined during eight years' collecting, an intermediate example. The species is not included in Dr. Jordan's Manual of Vertebrates of the Northern United States.

Chrysemys marginata, Ag.

Very abundant in ponds and lakes throughout Illinois. It is much like *C. belli*, but may be distinguished by the different markings of the plastron. It has probably been mistaken for the eastern *C. picta*, a species which has been recorded from Illinois, but which I am inclined to believe does not occur in the State.

Pseudemys troosti, Holbr.

Not common anywhere within our limits. Three fine examples taken by the writer from a pool on an island in the Mississippi River at Quincy are the only ones in the State Laboratory collection. It occurs also in the lower Wabash region.

Pseudemys concinna, LeC.

This is a southern terrapin closely related to the edible *P. rugosa*. A fine large example was sent me some years ago from Mt. Carmel, Ill., where it was captured by my friend, Dr. J. Schenck. Several others have been observed in the same locality. The extralimital distribution of the species includes all the States from North Carolina to Texas. It occurs also, according to Prof. Louis Agassiz, in Arkansas and Missouri

The Illinois example, a large, finely-developed one, is abnormal in the possession of a pair of symmetrical supernumerary marginal plates, one on each side of the nuchal plate, making thirteen for each side and twenty-six in all. The serrated mandible will distinguish the species from the *P. hieroglyphica*, which also occurs at Mt. Carmel.

Not mentioned in Dr. Jordan's Manual of Vertebrates.

Malacoclemmys lesueuri, Gray.

Very abundant in all our rivers, where it is known as the mud turtle. The head of this turtle is rather small, and the jaws are narrow compared with those of the next species. It may always be distinguished from *M. geographicus* by a comma-shaped yellow spot behind each eye. In some examples these may be isolated, but in that case their transverse position is characteristic. There is no tympanal stripe like that of the next species. The dorsal plates are sometimes said to be imbricated, but this is hardly exact, since the sutures between the plates are always visible. The food of examples taken from bottom-land pools at Quincy in 1888, consisted largely of the bulbs of a sedge which Prof. T. J. Burrill thinks is *Cyperus phymatodes*. Occasional remains of mollusks and crayfish were also noted in stomachs.

Malacoclemmys geographicus, LeS.

Equally common with the preceding and frequenting the same waters. Very different from *M. lesueuri* when adult, and easily distinguished at all stages. The head of fully grown examples is as large as that of snapping turtles of the same size. The alveolar surfaces of the jaws are greatly expanded, those of the upper jaw forming elevated tables into which the palatine bones enter largely, and which have sharp inner margins which almost meet at the middle line. The characteristic marks are a spot of greenish yellow behind each eye, which is isolated and directed longitudinally, and a stripe of the same color which originates on the tympanum and extends downwards, then backwards, upon the neck. The great expansion of the jaws is related to the food habits. An examination of numerous stomachs shows it to feed upon mollusks.

Ophisaurus ventralis, Linn.

Formerly common on the prairies of the central part of the State, but now being rapidly exterminated there by the close grazing and cultivation of the land. Still rather common in southern Illinois.

Oligosoma laterale, Say.

Occasional in Southern Illinois.

Agkistrodon piscivorus, Holbr.

Extremely common in bottom-land pools along the Mississippi River in southern Illinois.

Coluber constrictor, Bd. & Gir.

The prairie form of this species is of a dull slate-color above, becoming blue on the sides and belly. It is known everywhere as the blue racer. In southern Illinois the more slender black variety is common. The "black snake" of the prairie regions is very frequently a different species,—the *Elaphis obsoletus*.

Eutænia radix, Bd. & Gir.

In the latest edition of his Manual of the Vertebrate Animals of the Northern U. S., etc., Prof. Jordan gives the distribution of this serpent as "Wis. to Oregon." It is certainly very common in the central part of Illinois, as far south as Champaign county. I have not seen it in Kentucky.

Tropidoclonium lineata, Hallowell.

This is the type of Hallowell's genus Microps (preoccupied) and of Cope's genus Tropidoclonium. The anal plate is entire, while in *Regina kirtlandi*, a species often placed in the genus Tropidoclonium, it is divided. Three examples were taken at Urbana, Illinois, in April, 1889. The largest of these measured 13¾ inches in length, and was thus considerably larger than the example from which the original description was drawn. The three examples from Illinois differ from Hallowell's type in that the eye is above the third supralabial plate, not above the third and fourth.

Head small, not marked off from the body. Eye very small. One nasal plate, grooved below the nostril. Loreal present. One anteorbital; two postorbitals; two small internasals; two prefrontals. Frontal longer than broad, sides nearly parallel. Six supralabials (seven on one side in one of the examples), third and fourth largest, eye above the third, the fifth crowded away from the margin. Dorsal scales in nineteen rows, three outer rows with scales smooth and shining, first row with no carinæ, second row with very faint carinæ. Ventrals 138–150. Subcaudals 26–34 pairs, the first number being from an example in which the tail was probably imperfect.

Color above dark brown, with a gray stripe one and two half scales wide extending from occiput to tip of tail. Three outer rows of scales gray, each scale of the first row with a black spot at base. Head olive brown above; supralabials gray. Beneath ranging from whitish in small examples to gray in the largest one. Each ventral plate of the largest example with a transverse black spot in the middle of its base, each spot after the first ten or so, notched behind at its middle. Towards the vent the notches grow deeper, and a short distance before it, separate the spots into two. In the smaller examples these spots are all divided. Subcaudals, each with a black basal spot in the largest example; wanting in the smaller ones.

This is not the first record of the occurrence of this serpent north of the Ohio River. In Dr. Yarrow's list of the reptiles and batrachians in the United States National Museum, I find "Hughes, Ohio," given as the locality for an example. It bears a superficial resemblance to species of Storeria.

Not mentioned in Dr. Jordan's Manual of Vertebrates.

Hydrops abacurus, Gray.

A fine example of this beautiful serpent is in the State Laboratory collection from Union county.

Rana palustris, LeC.

The only examples which I have seen from the State were collected by me some years ago in the western part of Union county, in southern Illinois. They differed from all the eastern examples I have examined, in having the two central longitudinal rows of spots completely fused in two broad stripes. The species does not occur on the prairies.

Rana pipiens, Schreber.

This is the *R. virescens* and *R. halecina* of authors. The prairie variety is of a decided green above, with large spots encircled with white. The vocal sacs are very small, and no evidence of their presence is visible from without. The note is a low gutteral croak quite unlike that of the eastern variety, as described by Prof. E. D. Cope (Standard Natural History). In southern Illinois and along the Mississippi River is a variety generally of a coppery color with small spots, the anterior of the three, so conspicuous on the head of the prairie variety, being generally wanting.

Hyla cinerea, Schn.

An example of this beautiful tree-frog was taken from lily pads at the edge of Bluff Lake, Union county, Illinois, some years ago. Judging by the frequency with which the peculiar bell-like note was heard at the time, the species is common in the locality. The single example taken conforms more closely with the variety *semifasciata* than with the type forms of the species. It differs from the latter in its greater size, and in that the lateral pale stripe terminates on the middle of the side.

It is not mentioned in Dr. Jordan's Manual.

Chorophilus triseriatus, Wied.

This is the characteristic prairie "tree-frog." It is always found upon the ground or in the water, and never, as far as I have observed, mounts upon vegetation. It occurs in very great abundance in ponds and ditches in early spring, being the first of the ecaudate forms to appear. The most nearly musical of all our amphibians.

Bufo lentiginosus, Shaw.

Two very different varieties of this species occur in Illinois. On the prairies is found a large sluggish toad which gathers in great numbers in the ponds after the salamanders and tree-frogs are gone. Its skin is extremely warty, and the ventral surface is mottled with black, often so closely as to give the prevailing color. Its note is a high prolonged trill.

In the south part of the State is a more active toad with a smoother skin and white ventral surface, with at most a black spot on the chest. The note of this variety is a singular squawk which it is hardly possible to represent in words. This variety is the only toad which occurs in Kentucky. I have seen no intergradation of the two, and am inclined to think they may be distinct species. The northern form is probably the *B. lentiginosus*, var. *americanus*, and the southern form the var. *lentiginosus* of authors.

Diemyctylus viridescens, Raf.

Rather common in southern Illinois, but never observed on the prairies of the central counties. The relation of *D. viridescens* and *D. miniatus* as *forms* of one species appears to have been conclusively established by several observers.

Amblystoma microstomum, Cope.

Not rare in the prairie ponds in spring, becoming commoner eastward. A good Amblystoma.

Amblystoma tigrinum, Green.

This is the commonest salamander of the temporary ponds on the prairies of Illinois. Thousands collect in these to breed, as soon as the snow disappears in spring. The shallow water sometimes freezes after they have resorted to it, and many are then destroyed. The eggs are laid in large masses attached to dead vegetation. The very young are provided with "balancers" like those of the related *A. punctatum*. Fully grown examples still retaining rudiments of branchiæ and the imperfect tongue of the larva are sometimes taken, a condition probably to be accounted for by the fact that the eggs are occasionally deposited in waters from which the young cannot readily escape. It is just possible that the larval characters might be retained by this species indefinitely in case of an enforced residence in the water.

ARTICLE XI.—*Descriptions of new Cynipidæ in the Collection of the Illinois State Laboratory of Natural History**. By C. P. GILLETTE, of the Iowa Experiment Station.

FAMILY CYNIPIDÆ.

SUBFAMILY CYNIPINÆ.

GENUS DIASTROPHUS HARTIG.

D. scutellaris n. sp.

GALL-FLY.—Female.—Head, thorax, and scutellum black; mandibles, antennæ, legs, and abdomen yellow-rufous. Length, 3 mm.

Head black, shining, face coarsely striate and sparsely haired, frontal carina rather prominent and striate, a deep groove extending up on the front, from between the antennæ, containing the middle ocellus at its upper end, the ridges or carina on either side of the groove finely aciculate, the outer ocelli borne on the summit of the vertex, the latter shining and having a few punctures in the vicinity of the ocelli; occiput aciculate. *Thorax:* collar covered with a growth of rather long hair, mesothorax black, polished, and covered with a network of microscopic depressed lines, humeri coarsely aciculate

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* The following descriptions of new Cynipidæ were made during a recent vacation visit at the Illinois State Laboratory of Natural History, and it is through the kindness of the Director, Dr. S. A. Forbes, and Hon. R. P. Speer, Director of the Iowa Experiment Station, that I am permitted to publish them in this Bulletin.

I wish here to express my most hearty thanks to Dr. Forbes for the free use allowed me of the library, collection, microscopes and other laboratory equipments during my visit, and also for the excellent cuts made under his direction to illustrate the present paper. Mr. C. A. Hart and Mr. John Marten I have to thank for many favors received.

Types of all the species here described may be found in the collection of the Laboratory.

or wrinkled, pleuræ finely aciculate and rufous in color. The parapsidal grooves and median groove are broad and very deep near the scutellum, but become narrower and shallower as they extend forward; the parapsides extend to the collar, but the median groove disappears on reaching the posterior ends of the two parallel lines extending back from the collar. The lateral grooves* are very distinct. Scutellum bifoveate, coarsely sculptured, and remarkable for being much drawn out posteriorly. The length of the scutellum is nearly equal to the distance from the scutellum to the collar. *Abdomen* entirely yellow-rufous, 2d segment occupying about one half of the dorsal surface, 3d segment about two thirds as long as the 2d, following segments very narrow; surface polished, impunctured. *Feet*, including coxæ, entirely yellow-rufous. *Wings* hyaline or very slightly smoky, radial nervure very distinctly bowed, the tip being thrown towards the costa; 1st and 2d transverse nervures very heavy, the usual dark stain at the base of the radial nervure present, areolet medium.

Described from a single female taken by sweeping in a wheat field 20th May, 1884. Accessions number, 1881. Illinois.

Gall unknown.

GENUS ANTISTROPHUS WALSH.

A. silphii n. sp.

GALLS.—Abrupt sub-globular swellings from 1 to $1\frac{3}{4}$ inches in diameter at the tips of the stems of *Silphium integrifolium* and *perfoliatum* (Plate IX., Fig. 1). The inner portion of the gall is made up almost entirely of a rather dense pithy material that cuts with some difficulty. Interspersed through the gall are numerous oval larval cells, and also open spaces or cavities that do not contain insects. (Plate IX., Fig. 2.) The larval cells are not woody, as is usually the case in cynipidous galls, but their walls are of pith like the surrounding gall substance.

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* The short grooves starting on the mesothorax at a point near the outer angles of the scutellum and extending outside of the parapsides to a point about opposite the bases of the wings, I shall term *lateral grooves* in these descriptions to distinguish them from the other lines of the mesothorax.

These galls are very common in the vicinity of Champaign, Ill., on stems of *Silphium integrifolium*, and Mr. Hart had collected similar galls at Normal, Ill., from *S. perfoliatum*, from which flies were reared that were in every way identical with those from galls of the other species.

Gall-fly.—Female.— Black, head and thorax opaque, abdomen shining, antennæ, except first two joints, spot on mandibles, and anterior and middle pairs of tibiæ, ferruginous or dusky ferruginous. Length, 3–4 mm.

Head: Face deeply and densely striate, median ridge, below the insertion of the antennæ, densely and finely sculptured but not striate; genæ, vertex, and occiput densely sculptured, the sculptures being in the form of minute shining pits, as seen under a power of 70 diameters. *Thorax:* collar and mesothorax finely and deeply sculptured, parapsidal grooves distinct, median groove broad at scutellum and traceable to collar, lateral grooves distinct, all of the mesothoracic furrows sculptured at the bottom. The two parallel lines running back from the collar appear smooth and shining. Scutellum bifoveate, coarsely wrinkled posteriorly and finely and densely sculptured throughout, including the bottom of the foveæ and the spaces between the wrinkles; pleuræ opaque and sculptured like the mesothorax but less deeply. The sculpturing of this insect may be described as a net-work of raised lines enclosing smooth shining spots. *Abdomen* piceous black, polished, 2d joint occupying one half of the dorsal surface, 3d joint one half as broad as the second, succeeding joints to 7th usually plainly visible, 4th and succeeding joints finely punctured. A power of 70 diameters shows slight punctures on 3d segment also. *Antennæ* 14-jointed, rufous, except the first two joints, which are usually black, but sometimes inclined to rufous, joints 1 and 2 stout, joints 3 and 4 equal in length, last joint once and a half as long as the preceding, length of entire antennæ 2–4 mm. *Wings:* hyaline, radial cell open, radial nervure reaching costal margin, all the nervures very slender, areolet wanting. The entire insect is very free from pubescence.

The male differs from the female by being but 2¾ to 3 mm. in length, on account of its smaller abdomen, and by having the last joint of the antennæ as long as the two preceding joints.

Described from 60 bred specimens bearing accessions numbers 1928, 5206, 15605, and 15665, all from Illinois.

The flies live over winter in the galls and emerge from them during the months of May and June of the following year.

A. laciniatus n. sp.

GALLS.—Individual galls are egg-shaped, from 4 to 5 mm. in length, and occur in clusters on the receptacles of the flowers of *Silphium laciniatum.* (Plate IX., Fig. 3.) Mr. C. A. Hart has collected a number of these gall-clusters and in description of them says: "They always occur in well-ripened, healthy-looking flower heads, but do not show until the weather has removed the uninfested flowerets. They are always produced in the sterile flowers of the disk, towards the center."

GALL-FLY. — Female. — Head and thorax opaque black, abdomen shining rufo-piceous, antennæ black; length, 3 mm.

Head: face between eyes and mouth rather coarsely aciculate, median ridge with a few coarse punctures or pits, entire surface of head finely and densely sculptured, as in the preceding species, middle ocellus at the upper extremity of a broad furrow extending up from the antennæ, the two outer ocelli on the summit of the vertex, mandibles rufous on median portion. Antennæ black, 13-jointed, joints 3 and 4 equal, last joint almost as long as the two preceding; length, 2.3 mm. *Thorax,* including scutellum, as in the preceding species. *Abdomen* rufo-piceous, polished, rather globose, 2d segment occupying scarcely more than one third of the dorsum, 3d segment broad, 3d and succeeding segments densely punctured. *Wings* hyaline, pubescent, nervures very light, areolet wanting. *Feet,* including coxæ, black; tip of femora, tarsi, and anterior tibiæ rufous.

Male.— Length, 2 mm.; antennæ 14-jointed, as long as the body; abdomen black, 2d segment occupying fully one half of the dorsum; otherwise as the female.

This species is easily distinguished from *A. silphii* by the black antennæ, which are 13-jointed in the female, by its much less robust thorax, by its more globose abdomen, and by having the third abdominal segment densely punctured.

Described from three males and three females bred from galls collected at Champaign, Ill., by Mr. John Marten. Accessions number, 15073.

A. rufus n. sp.

While looking through the Laboratory collection for Cynipidæ I was much interested in finding a vial containing a section of a stem of *Silphium laciniatum* and a number of two species of Cynipidæ bred from it. There was not the slightest indication of a gall upon the stem, and it was found that the flies had emerged from little cells in the pith exactly like the cells in the pithy substance of the galls of *A. silphii*, above described. In company with Mr. C. A. Hart I visited fields where this species of *Silphium* was growing, and we found that the majority of the stems were more or less infested with cynipidous larvæ, hundreds of which could, in some cases, be found in a single stem; but in no case was there any indication of the formation of a gall. An illustration of a stem containing these cells is given at Fig. 4, (Pl. IX). After finding the stems of *Silphium laciniatum* so much infested, we pushed our investigations farther and found similar larval cells abundant in *Silphium perfoliatum*, *S. terebinthinaceum*, and *S. integrifolium*. Whether the flies when bred from these stems will all prove to be one or the other of the two species here described, cannot yet be told.

GALL-FLY.— Female.— Color, rufous; vertex, mesonotum, and scutellum black; head and thorax opaque; length, 3 mm.

Head and thorax minutely sculptured throughout as described in the two preceding species, face finely aciculate between eyes and mouth, vertex and the portion of the occiput immediately back of it black, tips of the mandibles infuscate, the remainder of the head rufous. Antennæ 13-jointed, 4th joint a trifle longer than the 3d, the last joint as long as the two preceding and bearing a connate suture that in some positions makes it appear to be two joints, rufous in color, and 2 mm. in length. *Thorax:* parapsidal furrows extending to collar, median groove not quite reaching the two parallel lines from collar; lateral grooves distinct. The median portion of the pleuræ appears finely aciculated, but they are finely sculptured throughout. Scutellum bifoveate and more coarsely sculptured than the mesonotum but not wrinkled like the two species just described. Foveæ broad and shallow and sculptured at bottom like the rest of the scutellum. *Abdomen* dark rufous, almost black above, 2d segment occupying somewhat less than half of the dorsum, apical portion of 3d segment feebly punctured, following segments, except 7th, more strongly and densely punctured, 7th segment covered with a net-work of fine lines but no punctures. *Wings* hyaline, nervures, except the two transverse, very slender, areolet wanting. *Feet*, including coxæ, entirely rufous, tibiæ of the hind pair in a few cases rather dark.

Male.—Length, 2.2 mm., 2d abdominal segment occupying half of the dorsum, antennæ 14-jointed, last segment once and a half as long as the preceding; otherwise as female.

Described from numerous bred specimens from alcohol; accessions number 5500. Illinois.

A. minor n. sp.

Bred from the same stem of *Silphium* as the preceding species and about half as numerous.

Gall-fly.—At first sight the flies of this species appear to be miniatures of *A. rufus*, but there are structural differences that make it necessary to give them a separate description. They differ from *rufus* as follows:

Length of females 2 mm., of males 1½ mm.; collar deeper rufous. The most apparent structural differences are in the mesothorax and scutellum. The parapsidal and median grooves in *minor* do not appear as sharply defined furrows but only as broad slightly depressed lines with sloping sides. The foveæ of the scutellum are rather deep at base, extend far back, and are not separated by a sharply defined septum but by a broad slightly elevated ridge. The scutellum is also longer in proportion to its breadth and is perceptibly narrowed at the sides, about midway of the length.

Accessions number, 5500.

A. bicolor n. sp.

Gall-fly.—Female.—Head and thorax opaque black, abdomen and antennæ rufous; length, 3 mm.

Head black, finely and densely sculptured, mandibles except tips rufous, face between eyes and mouth coarsely aciculate, frontal ridge rather prominent, ocelli in nearly a straight line. Antennæ dark rufous, 13-jointed, 3d and 4th joints equal in length, 13th joint about as long as the two preceding taken together. *Thorax*, including pleuræ, densely and finely sculptured, parapsidal and median furrows distinct and extending to the collar, lateral furrows and two parallel lines plainly marked. Scutellum sculptured like the mesonotum, bifoveate. Abdomen rufous, polished, 2 1 segment occupying a little more than one third of the dorsum, 3d segment very broad, and microscopically punctured on apical portion, succeeding segments to the 7th all exposed and rather densely punctured as seen under a power of 70 diameters, venter rather prominent, and ovipositor sheaths projecting slightly. *Feet*: the tarsi, tibiæ of front pair, and joints of all the legs are more or less rufous, the remaining portions black. *Wings* hyaline, radial cell open, all the nervures, except the two transverse, very weak, areolet entirely wanting.

Described from a single specimen from Normal, Ill., accessions number 2584. Gall unknown.

GENUS ACRASPIS MAYR.

A. compressus n. sp.

Gall.—Small sub-globular bodies from 2 to 3 mm. in diameter attached to the under side of the leaves of the red oak, *Quercus rubra*, in the fall, about the time the leaves are beginning to turn brown. The galls appear like wax, and are either pure white or tinged with red while on the leaves, and when cut into are fleshy and juicy like a potato. The galls fall to the ground with or a little before the leaves, and each develops a single larva which gets its growth in the fall but does not emerge until the following summer. Only a very thin shell of the gall is left after the fly emerges.

GALL-FLY.—Females.—Head and thorax rufous, abdomen black, head nearly twice as broad as thorax, the latter very small and narrow, abdomen very much compressed and, when viewed from the side, appearing twice as large as the head and thorax together.

Head: face and genæ reddish brown, vertex and occiput dark brown, mandibles black, clypeus punctured and with few hairs, the entire head covered with a net-work of depressed lines; antennæ rufous, 14-jointed. *Thorax* very small and narrow, seeming, when viewed from above, out of all proportion with the comparatively large and very broad head; sculptured like the head without the usual furrows; scutellum very narrow and much elevated posteriorly, and appearing, when viewed laterally, in the shape of a crow's beak; a shining transverse groove but no foveæ at base. *Abdomen* very strongly compressed, not broader in the thickest part than the thorax, shining black in color with some rufous at base, free from hairs or punctures, as deep as long, its length compared with that of the entire insect being as 3 to 5 and the 2d segment occupying fully two thirds of the dorsum. *Feet* dark reddish brown. *Wings* entirely wanting.

Described from two specimens cut from galls taken at Ames, Iowa, where they are common.

GENUS DRYOPHANTA FORST.

D. lanata n. sp.

GALLS.—During late summer and autumn the galls of this species are found on the under side of leaves of *Quercus rubra* and *Q. coccinea*, appearing externally as little bunches of compact brown wool (Pl. IX., Fig. 5), and hardly distinguishable in outward appearance from the galls of *Andricus flocci* Walsh. The galls seldom occur singly, but usually in clusters of from four to eight. A cluster of eight galls when fully grown will measure about $\frac{3}{8}$ of an inch in width by $\frac{5}{8}$ of an inch in length. An individual gall when denuded of its covering is in the form of an irregularly shaped cone with a bulging base, the diameter of the base being three or four sixteenths of an inch, which is nearly twice the height.

PLATE IX.

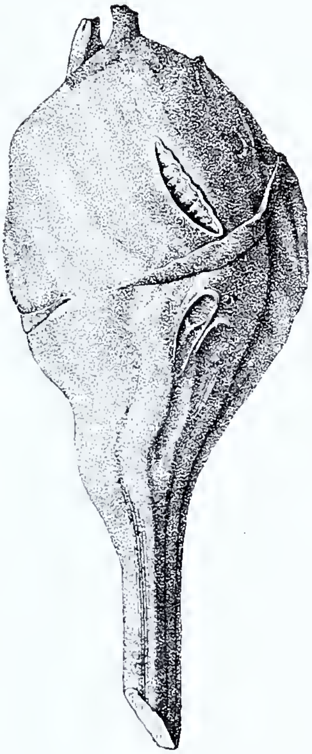

FIG. 1.

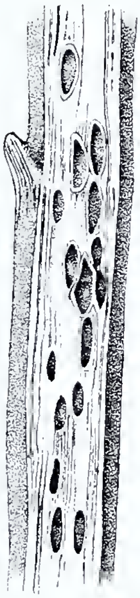

FIG. 4.

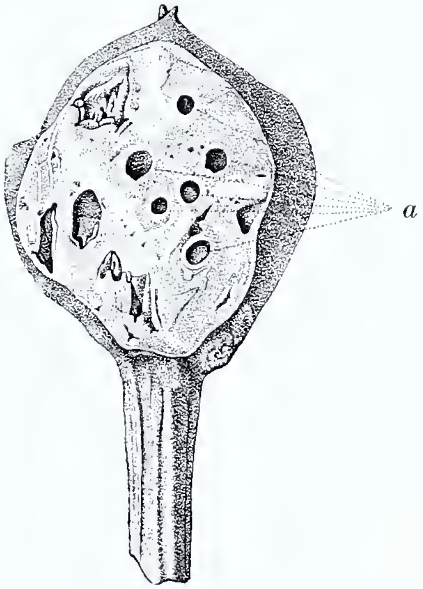

FIG. 2.

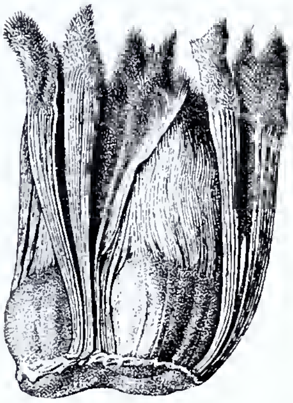

FIG. 3.

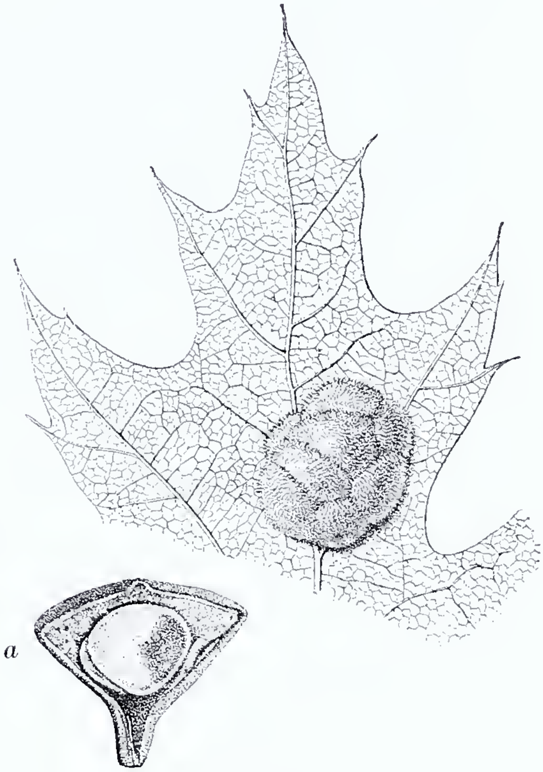

FIG. 5.

The galls fall to the ground in the autumn in advance of the leaves, and the flies emerge the following summer. The galls are abundant at Ames, Iowa, and I have taken a number in the vicinity of Champaign, Ill.

GALL-FLY.—A robust, black species, with more or less rufous on face, mesonotum, scutellum, and sides of abdomen. Length, 3½ to 4 mm.

Head: Face scabrous, shining, with very few hairs; vertex black, sub-opaque, finely and densely sculptured; ocelli considerably elevated, clypeus polished, emarginate, punctured; antennæ black, 14-jointed (in one specimen 13-jointed), a trifle over 2 mm. in length; joints 1 and 2 stout, the latter subglobular, joint 3 one third longer than joint 4, last joint scarcely longer than the preceding. *Thorax*: mesothorax covered with a fine net-work of depressed lines leaving irregular raised portions that are highly polished, parapsides narrow but well defined, polished at the bottom and reaching the collar, median groove showing plainly at scutellum but soon disappearing as it runs forward; the two parallel grooves from the collar narrow at first, then spreading out in broad furrows with sloping sides traceable about one third of the way to the scutellum; lateral grooves plainly marked, extending well forward, and approximating the parapsides at their anterior extremity; pleuræ finely aciculate and shining. Scutellum bifoveate, the foveæ shallow, separated, not by a septum, but by a number of polished raised lines that run into the smooth surfaces of the bottoms of the foveæ; lateral borders of the scutellum strongly aciculate anteriorly, the lines becoming crooked and broken posteriorly and forming a densely and deeply rugose surface; scutellum black at base and tip and rufous in the middle. *Abdomen* dark rufous to almost black, 2d segment occupying one half of tergum, posterior half of the second segment and all of the following segments rather densely punctured, all of the segments highly polished. *Feet* uniformly colored, very dark rufous to almost black. *Wings* hyaline, rather densely ciliate, 4 mm. long, submedian and 1st and 2d transverse nervures stout and black, areolet medium.

Described from two bred females from galls taken at Ames, Iowa. Male unknown.

GENUS CHILASPIS MAYR.

C. ferrugineus n. sp.

This genus has hitherto had no recognized representative in this country. Dr. Gustav Mayr, in his paper on "Die europäischen Arten der gallenbewohnenden Cynipiden," gives a single species, *C. nitida* Gir., for Europe. Giraud's species is given as producing galls on the leaves of *Quercus cerris*, while the species here described is either a guest or a parasite, as two of them were captured in the act of ovipositing in immature galls, one of *Dryophanta lanata*, described above, and one in a very similar gall of an undescribed species; both were taken 1st Sep., 1890, at Ames, Iowa.

I have never seen a specimen of *C. nitida*, and it is possible that the species here described will require a new genus, but by the use of Mayr's synopsis these flies are readily traced to *Chilaspis*.

FLIES.—Females.—General color yellow-rufous, abdomen shading into black on apical dorsal portion, tips of mandibles black, posterior tibiæ and tarsi somewhat infuscate, length 2 mm.

Head: face finely rugulose and having the appearance of being covered with scales like the body of a fish, a few scattering hairs, clypeus in the upper and middle portion sculptured like the rest of the face but with a broad polished margin below, mandibles punctate, vertex and occiput covered with a fine net-work of depressed lines and blackish in color; antennæ 13-jointed, 3d and 4th joints equal in length, last joint twice as long as the preceding, ferruginous, reaching to the middle of the abdomen. *Thorax:* mesothorax ferruginous, quite dark in one specimen, sculptured like the face, parapsides distinct throughout but in the middle showing as broad shallow grooves without well-defined sides, median groove absent, parallel lines from the collar plainly marked, lateral grooves distinct and reaching to opposite the bases of the wings; pleuræ covered with a net-work of slightly raised lines; scutellum with polished basal groove crossed by many shining ridges, coarsely rugose posteriorly and with a narrow blackish rugose margin; metathorax coarsely rugulose and with three longitudinal carinæ running to the base of the abdomen. *Abdomen*, with 2d segment occupying fully half of the dorsum, 3d segment about one third as long as the 2d, seven segments visible, ovipositor sheaths projecting above the dorsum, venter considerably extended posteriorly, the last two characters reminding one of *Ceroptes* sp. *Wings* hyaline, with distinct dusky patch surrounding the second transverse nervure, radial cell entirely open, the radial and subcostal nervures ending abruptly just before reaching costal margin, the subcostal, radial, and first and second transverse nervures stout, the others very slight, the areolet, consequently, rather faint but of medium size.

Described from two females taken while ovipositing in galls as above mentioned and one specimen captured at large; all from Ames, Iowa.

GENUS AULAX HARTIG.

A. bicolor n. sp.

GALL-FLY. — Female. — Head and thorax black, feet and abdomen yellow-ferruginous; length 2½ mm.

Head black, shading into rufous between the eyes and mouth, mandibles except tips rufous, face finely wrinkled, vertex and occiput finely sculptured, the sculpturing of the genæ making them appear to be covered with scales like the body of a fish, ocelli on a flat or somewhat depressed surface; antennæ dark rust-brown, darkest toward the tips, 13-jointed, joints 3 and 4 equal in length, last joint as long as the two preceding. *Thorax* black, shoulders rufous, mesothorax finely sculptured, opaque, clothed with sparse recumbent pubescence, parapsidal grooves very distinct and rather deep, median groove very short and much broadened at scutellum so as to be almost triangular. The lateral grooves appear as polished lines only, and the two parallel lines from the collar are rather indistinct; pleuræ densely and rather coarsely aciculate. Scutellum black, with two small, shallow, oblique foveæ, rather coarsely rugose, the surface somewhat obscured by pubescence. *Abdomen* rufous, shining, 2d segment occupying about one third of dorsum, 3d joint a little more than half as long as the 2d, following joints to the 7th gradually shorter, joints 3–7 inclusive finely punctured. *Feet*, including coxæ, of the same color as the abdomen. *Wings* hyaline, rather densely ciliate, radial cell closed, areolet medium.

Described from two females, one taken in a wheat field at Mt. Carmel, Ill., 27th May, 1885 (accessions number 1781), and one taken at Champaign, 9th July, 1885 (accessions number 6422).

SUBFAMILY INQUILINÆ.

GENUS SYNERGUS HARTIG.

S. magnus n. sp.

Head rufous-yellow, vertex and thorax entirely black, abdomen rufous-yellow, except a narrow black stripe along the tergum of the 2d segment, feet light yellow, except the tibiæ and tarsi of the hind pair which are infuscate; length 4 mm.

Head: face coarsely striate, vertex and occiput microscopically rugulose and with broad punctures; antennæ black, as long as the insect, 15-jointed, 3d joint but little longer than the 4th. *Thorax* with coarse transverse wrinkles, parapsides distinct throughout, median groove reaching the posterior ends of the parallel lines; the lateral grooves appear more like ridges and are short and oblique; shoulders coarsely wrinkled, pleuræ very coarsely aciculated below and very finely aciculated above, with a smooth shining spot midway upon the most prominent part. Scutellum with two small foveæ and coarsely rugose. *Abdomen:* first segment, as well as the petiole of metathorax, coarsely wrinkled or fluted, 2d segment occupying nearly the whole surface of the abdomen, ovipositor sheaths long and projecting upward above the line of the tergum, venter considerably projecting. *Wings* long, narrow and slightly smoky, areolet medium.

Described from a single specimen from my private collection that was reared from a gall of *Amphibolips cookii* at Lansing, Mich.

S. villosus n. sp.

The front, above the insertion of the antennæ, the vertex, a broad stripe extending over the occiput to the collar, the entire thorax, a broad blotch on second abdominal segment extending far down at the sides, the tips of the mandibles, and a spot upon the tergum of the 5th abdominal segment, black; feet, including coxæ, very light yellow, orbits and antennæ slightly rufous, other parts light yellow.

Head: face rather finely striate, vertex and occiput with numerous coarse punctures on a microscopically sculptured surface, antennæ 15-jointed, nearly as long as the body. *Thorax:* mesonotum with fine transverse ridges, the furrows between bearing coarse but shallow and somewhat confluent punctures, parapsidal grooves very distinct, median groove narrow and extending but a short distance, parallel lines and lateral furrows not very distinct, pleuræ coarsely aciculated below, finely above, and with a smooth polished median spot. Scutellum bifoveate, rather coarsely sculptured, foveæ shallow, the sculpturing somewhat obscured by pubescence. *Abdomen:* first joint, as well as petiole of metathorax, fluted, 2d segment occupying nearly the entire surface and deeply notched on posterior margin of the tergum, exposing the tergites of three or four following segments, ovipositor sheaths projecting above the surface of the abdomen, venter rather prominent. *Wings* hyaline, areolet rather indistinct.

Described from two specimens bred from the galls of *Acraspis villosus*, taken in Iowa.

SUBFAMILY FIGITINÆ.

GENUS COPTEREUCOILA ASHM.

C. marginata n. sp.

Female.—Black, 1.2 mm. in length, antennæ clavate, apical margin of the wings emarginate.

Head black, mandibles ferruginous, face and vertex smooth and shining, occiput finely rugose. Antennæ 13-jointed, clavate, joints 1, 2, 11, 12, and 13 thick, and joints 1, 11, 12, and 13 about equal in length; joint 2 globose and about equal to joint 3 in length; joints 3–10 slender and joints 4–10 but little longer than broad; last three joints suddenly and greatly enlarged. *Thorax:* collar narrow, mesonotum smooth and shining, without grooves. Scutellum deeply bifoveate, polished. The rather narrow but much elevated central area appears as a broadening out of the carina separating the foveæ, and has a rather large pit near its posterior margin and two conspicuous punctures immediately in front of it. The broad deeply depressed margin of the scutellum is finely wrinkled or aciculate. *Abdomen* at base with a dense growth of fine woolly hair, and there is also a small patch of similar hair on either side of the metathorax; 2d segment occupying nearly the entire surface of the abdomen, abdomen rather long and pointed. *Feet* and antennæ in one specimen are entirely yellow-ferruginous, in two others the feet are dark ferruginous and the antennæ are black. *Wings* hyaline, broadly and rather deeply emarginate on apical margin, ciliate, heavily fringed, and the triangular radial cell open on the costal margin.

Described from three specimens from Illinois. Accessions numbers, 1661, 3336, 5437. Male unknown.

GENUS EUCOILA WEST. (*Cothonaspis Hartig*).

E. 7-spinosa n. sp.

Female.—Black; feet, mandibles, and antennæ clear shining rufous; length, 3 mm.

Head: face smooth and polished, with a puncture just beneath the insertion of each antenna and about six punctures near the lower inner orbit of each eye, also a few scattered punctures on vertex, just back of the ocelli. *Thorax:* dorsal margin of collar elevated and emarginate and with a conspicuous growth of coarse yellow hairs upon either side, mesonotum and pleuræ smooth and polished and without grooves or sculptures. Scutellum deeply bifoveate, the elevated central area with a large pit near its posterior margin, and in front of this pit, near the margin on either side, are three coarse setigerous punctures. The broad depressed margin of the scutellum is coarsely rugose. *Abdomen* with a narrow girdle of rather coarse short hairs, 2d segment occupying nearly the entire surface, smooth and highly polished. *Wings* without pubescence on their surface, posterior border of anterior wings fringed towards base, radial area closed, areolet not at all developed, subcostal vein with seven stout setæ or spines.

Described from a single female formerly in the private collection of Mr. C. A. Hart and bearing accessions number 547. Taken in southern Illinois. Male unknown.

GENUS EUCOILIDEA ASHM.

E. rufipes n. sp.

Female.—Black; feet, mandibles, and antennæ rufous, mesonotum with parapsides converging and uniting in a broad sculptured area; length, 1.8 mm.

Head: face between eyes and mouth somewhat aciculate, about six aciculations on each side, front smooth, polished, and convex, vertex and occiput smooth and polished, head with scattering gray hairs. Antennæ 13-jointed, joints 3 and 4 equal in length, gradually incrassate towards the tip, hardly shorter than the body and freely set with short gray hairs. *Thorax:* mesothorax smooth and polished and along the suture bordering the collar, both dorsally and laterally, is a margin of deep pit-like sculptures; a row of these sculptures beginning at the outer posterior angle of the mesonotum, runs past the base of the wing and then along the lateral border of the mesonotum to the place where the parapsidal furrow usually terminates; from this point the row of sculptures extends over the mesonotum in the usual direction of the parapsidal groove and, after running a little more than one half of the distance to the scutellum, suddenly broadens out and, with the similar sculpturing of the other side, forms a broad deeply sculptured area reaching to the scutellum. There is a narrow median carina, forked at its posterior extremity, separating this sculptured area of the mesonotum into two equal parts. The sculptured lines divide the smooth surface of the mesothorax into three nearly equal areas. The elevated central portion of the scutellum has its large pit or depression centrally located, and there are about six punctures along either lateral border. The edge of this central area extends on all sides in a thin knife-like margin. The depressed border of the scutellum is coarsely rugose and punctate. *Abdomen* smooth, polished, and without show of hairy girdle at base; 2d segment occupying the entire surface of the abdomen. *Wings* fringed and rather coarsely ciliate, radial area closed.

EXPLANATION OF PLATE.

Fig. 1. Gall of *Antistrophus silphii* on *Silphium integrifolium*, slightly enlarged.

Fig. 2. Another gall of same species, with side cut away, showing internal cavities; *a*, larval cells; natural size.

Fig. 3. Galls of *Antistrophus laciniatus* on *Silphium laciniatum*, enlarged three diameters.

Fig. 4. Galls of *Antistrophus rufus* and *A. minor* in *Silphium laciniatum*, natural size.

Fig. 5. Galls of *Dryophanta lanata* on *Quercus*, natural size; *a* denuded gall, enlarged five diameters.

ARTICLE XII.—*Sixth Contribution to a Knowledge of the Life History of certain Little-known Aphididæ**. By CLARENCE M. WEED.

THE CORN ROOT APHIS. (*Aphis maidis* (?) Fitch.)

The literature and life history of the corn plant louse were discussed at length in 1884 by Professor H. Garman†, who showed that at that time nothing definite was known concerning the time or place of development of the sexed forms, the connection between the root and aërial forms, or the manner in which the insect passes the winter. In the article cited the author adds nothing of importance to our knowledge of either of these points, though the conjecture is made "that the lice hibernated as alate viviparous females."

In the autumn of 1885, however, Prof. Garman found a single colony of oviparous females on the roots of corn in an enclosed frame, and has described this form together with eggs obtained from the abdomen by dissection‡. Hence at the beginning of the season of 1887 there remained to be determined, (1) whether the species normally hibernates in the egg state, (2) when and where the eggs are laid, (3) the time of appearance of the male, and (4) what connection, if any, exists between the form on the roots and that on the leaves. The observations given below answer the first three of these queries, but I am not at present able to give any definite results concerning the obscure subject of the origin and fate of the aërial form.

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* The previous contributions of this series have been published as follows: first, "Psyche," Vol. V., pp. 123–134; second, "Psyche," Vol. V., pp. 208–210; third, Bulletin Ohio Agricultural Experiment Station, Second Series, Vol. I., pp. 148–152; fourth, Bulletin Ohio Agricultural Experiment Station, Technical Series, Vol. I., pp. 111–120; fifth, "Insect Life," Vol. III., pp. 285–293.

The investigations on which the present article is based were made in 1887 during my connection with the Illinois State Laboratory of Natural History, under the direction of Professor Forbes, to whom I am indebted for the opportunity of publishing them at the present time. The article was written in December, 1887, and is now printed in its original form. C. M. W.

Hanover, New Hampshire, April, 1891.

† 14th Rept. St. Ent. Ill., pp. 23–33.

‡ Misc. Essays on Economic Entomology, 1886, pp. 46–48.

FIELD OBSERVATIONS.

The first observations during 1887 were made in an oats field, on the University farm, that was last year planted to corn and abundantly infested with corn root lice. Two hours were spent, April 21, in searching the formicaries of the common brown ant (*Lasius alienus*) and of a larger red ant which was quite abundant, but neither plant lice nor their eggs were found. The Lasius were burrowing about the young oats plants, which had been up a week. April 25 I repeated the search, and found a mass of about fifty plant-lice eggs slightly below the soil surface in a Lasius nest. They were mostly green and nearly ready to hatch, and some of them put in a dry vial disclosed several young lice the following day. On April 29 another lot of aphid eggs, together with young lice, were found in another nest of *Lasius alienus* in the same field.

The young lice were on the radicles of the sprouting seeds of smartweed *(Polygonum incarnatum)* and Setaria, the earth about which had been mined by the ants. On May 4 larval lice were abundant on the plants just mentioned, always attended by ants. The majority of them were about half grown, but no adults were seen. By May 16 the stem-mothers had become adult, given birth to young, and largely disappeared, though a few were still present. The prevailing form then in the field was the young of the second generation, a few of which had become pupæ (of the winged form), but no winged adults were seen. Ten days later the corn lice had, so far as I could judge after an hour and a half of diligent search, completely disappeared from the field.

The second field under observation had been in corn for years and was again planted to corn last spring. I first examined it April 29 (before it had been plowed), when young lice were found abundant under the care of the ants on the young sprouts of Setaria and Polygonum. The following day a part of the field was plowed and larval aphides were found again in the nests of Lasius. On May 6, in a part of the field not yet plowed, half-grown specimens were found in an ant's nest. By May 21 the lice had been mostly transferred from the Setaria and smartweed to the young corn roots. Some stem-mothers were yet present, and a few wingless adults of the second generation were seen, but the great majority of the lice were the young of this latter form (i. e., those born from the stem-mothers). Two days later a large number of these had become adult, some of them winged but most wingless, and a large number of pupæ of the winged form were present, as were also a few stem-mothers. At this time the ants were mining about the corn plants all over the field, evidently preparing for the reception of the winged migrants, but as yet very few of these mined hills contained lice. June 1 all stages of the second and third generations were common throughout the field, many of the specimens being winged. On the 27th of the same month, however, only wingless adults and larvæ were found. No further observations were made in this field until October 10, when both wingless viviparous and oviparous forms were abundant, the most of the lice being young of the oviparous form. A week later the oviparous adults were most abundant, and the viviparous ones were scarce. Many of the oviparous adults were wandering around among the Lasius galleries apparently unmolested by the ants, which behaved very differently toward them from the way they act toward the viviparous forms earlier in the season. I watched repeatedly to see the ants pick one of the oviparous lice up when the nest was disturbed, but without success. In large ant colonies the oviparous forms had often wandered some distance from the corn roots.

In a field, as yet unplowed, that had been in corn the year previous I found (April 30) two separate masses of plant louse eggs in one nest of *Lasius alienus.* Many of the eggs had evidently already hatched, for there were numbers of young lice on the sprouting Setaria and smartweed.

In an oats field (following corn) on the University farm larval corn lice were found abundant May 4 on the roots of Setaria in an ant's nest.

In a field of corn on sod ground I noticed, May 31, that the ants were very busy mining about the young corn plants and evidently preparing for the reception of the winged migrants. In two hills I found single specimens of the winged corn root louse which had not yet begun to establish colonies. I picked one of these up and put it down by another hill where the ants were at work. Almost immediately a Lasius found it, felt of it with the antennæ, then grasped the base of the plant louse's wings with its jaws and carried it below.

I also found May 19 in a field northwest of Champaign (corn following corn) many adult viviparous females with young about them. The same day, on a neighboring farm, a winged corn louse was found on one of the upper roots of a corn plant (corn following sod). The ants had mined a considerable opening along the side of the stalk through which the louse must have entered. In the same field at the same time two wingless viviparous females were found at some distance from any corn field.

In a field of fodder corn (on corn ground) on the University farm wingless adults of the second or possibly third generation were abundant May 25. A single winged specimen was seen.

Winged and wingless lice were common on roots of corn in certain fields at Rankin, Vermilion county, July 1.

In a field in Urbana wingless root lice were abundant in hills of corn August 19, and infested hills were easily found.

During October and the early part of November I found the oviparous females repeatedly in various fields about Urbana.

BREEDING CAGE RESULTS.

On April 25 a mass of aphid eggs found in a nest of *Lasius alienus* in a last year's corn field were transferred to a breeding cage. The following day several lice had hatched. One of these was isolated on a corn root, and moulted for the first time May 2 and for the second time May 5. Unfortunately it died May 7, but it had become large enough to be recognized as a corn root louse.

In the nest where the above eggs were found were two very small plant lice, presumably hatched from the same lot of eggs as those mentioned above. These were placed (April 25) in a glass tube on a corn root, and I succeeded in bringing one of them to maturity, but the other died shortly after being transferred. The one that developed proved to be a corn root louse, and from it seven larvæ were born between May 9 and 15, at which latter date it died.

On April 29 I collected in the field several partially grown corn root lice on roots of Setaria and smartweed and placed them in a vial with earth and a Setaria sprout. May 4 one of the lice had apparently become adult, and it was transferred to a corn root inside a glass tube. May 5 it had fastened its beak in the root but no young had appeared; its markings were becoming more distinct. The following day a young louse was born about noon. The next morning (May 7, at 8 a.m.) no more young had been brought forth, but twenty-four hours later three more had appeared. The larvæ continued to be born until the 15th, when twelve had been brought forth, at which time the adult died.

Two of the young born from this stem-mother were brought to maturity, and curiously enough one of them was winged and the other apterous. The former, presumably one of those born May 6 or 7, became a pupa May 15 and did not again moult until May 19, when it became a full fledged adult. It was kept in the tube until May 22, but it brought forth no young up to that time, and did not insert its beak in the corn root, being apparently anxious to escape.

The wingless specimen was taken out of the tube where it was born, May 8, when it was not over a day old. It passed its last moult May 19, and the first larva was born from it May 21. Another was born the next day, when the observations ceased.

June 14 a hill of corn in the field which showed evidence of the presence of *Lasius alienus* was stocked with corn root lice. The lice were placed about the burrows of the ants and were almost immediately carried below. A gauze-covered frame was placed over the plants. July 5 the leaves of the plants were examined for aërial corn lice, but none were found. The frame was replaced and was not again taken off until October 20, when the leaves of the plants were carefully examined for aphides, but no traces of them were found. On the roots, however, there were numbers of oviparous corn lice with a few wingless viviparous ones and several males — a form which had never before been discovered. There was also a single winged viviparous root louse and a pupa of the same form. All were put in a watch glass over night, and the next morning one of the males was observed *in copula* with an oviparous female, thus establishing the sex of the former beyond a doubt. The pupa had also moulted and become a winged louse; and several of the oviparous females had laid yellow eggs. The fully developed oviparous forms were mostly of a peculiar yellowish pink color, probably due partially at least to the eggs within the abdomen. Many of the young lice in this corn hill were sucking the juices from the roots, which still had a little sap left in them; but most of the adults were wandering about in the galleries of the ant colony.

This experiment proved beyond reasonable doubt that the life cycle of the root form of *Aphis maidis* can be completed without the appearance of the aërial form. To determine whether there ever is any connection between the two forms will require more work.

SUMMARY.

Assuming for the present that there is no connection between the root and aërial forms of *Aphis maidis*, we are justified in the light of these observations in summarizing the life history of the former as follows (starting with the hibernating eggs in the nests of ants):

During the first warm days of spring, usually before the ground is plowed, there hatch from the eggs small greenish lice that are transferred by the ants to the roots and radicles of Setaria and Polygonum, where they are carefully tended by the ants. In about a fortnight these young have become adult stem-mothers (*"Pseudogyna fundatrix"*) and give birth to quite a number of young. In the mean while the ground has probably been plowed, and some crop sowed. In case this crop is corn the ants transfer the lice to the corn roots; but if it is oats or wheat they may continue to rear the lice on Setaria and Polygonum. The young from these stem-mothers become adult in about a fortnight, and some of them are apterous and others winged. The winged specimens fly to other hills either in the same or neighboring fields, where the ants are waiting to receive them and proceed to establish colonies. Whether in ground not planted to corn more of this second generation become winged than where corn is present, or not, I cannot say; nor do we know how long the lice can continue to develop on Setaria and Polygonum. This second generation bring forth viviparous young (mostly wingless); and generations of viviparous females continue to develop on corn roots throughout the summer. In autumn the true sexes are produced (both being apterous), and the eggs are deposited by the oviparous females in the mines of the ant colonies. These eggs are cared for by the ants through the winter, and the young lice that hatch from them in spring are provided for as described above.

DESCRIPTION.

Wingless male.—Body 1.4 mm. long; 7 mm. wide. Antennæ .9 mm. long; cornicles, .08 mm. long; cauda .05 mm. long.

Body flattened; sides nearly parallel between middle coxæ and cornicles; behind cornicles tapering rapidly to cauda: narrowing in front of middle legs. Greenish black with a glaucous bloom; head above black; dorsum of prothorax with a narrow black transverse band; dorsum of mesothorax with a similar wider band, dorsum of metathorax with a narrow band not extending to the margins,—all indistinct and in some lights not distinguishable. Eyes black; antennæ, legs, and cornicles blackish. Caudal segments of abdomen with indistinct transverse dark bands. Ventral surface of thorax blackish, of abdomen dark green with black patch at caudal extremity. Cauda hirsute. Margins of abdomen wavy. Legs long, hairy. Antennæ robust; joint I swollen; II about equal to I in length, but smaller; III longer than I and II; IV and V subequal, IV slightly longer; VI slightly longer than V, and VII about equal to VI, short for a filament. Cornicles short, slightly swollen, surface rough. Rostrum robust, reaching middle of posterior coxæ.

Described from two living specimens taken in nest of *Lasius alienus* about corn roots, October 21, 1887. One seen *in copula* with oviparous female.

Egg. Length, 7 mm; width, 3 mm. Yellow when first laid, becoming black during winter and changing to green just before hatching in spring.

Described from many specimens, some of which were obtained in breeding cages October 20–22, 1887.